BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF HAWAII

In The Matter Of PUBLIC UTILITIES COMMISSION. Instituting a Proceeding to Investigate the Implementation of Feed-in Tariffs	DOCKET NO. 2008-0273

JOINT PROPOSAL ON FEED-IN TARIFFS OF THE HECO COMPANIES AND CONSUMER ADVOCATE

AND

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Hawaiian Electric Company, Inc. and its subsidiaries Maui Electric Company, Ltd. and Hawaii Electric Light Company, Inc. (the "HECO Companies") and the Division of Consumer Advocacy, Department of Commerce and Consumer Affairs (the "Consumer Advocate"), herein provide their joint Proposal on Feed-In Tariffs ("FIT Proposal"). The FIT Proposal identifies the HECO Companies' and the Consumer Advocate's position and proposals regarding key policy and design elements of a feed-in tariff ("FIT"), which, in conjunction with the pricing and other information to be submitted by the parties to this docket as requested in the Commission's December 11, 2008 paper entitled "Feed-In Tariffs: Best Design Focusing Hawaii's Investigation" ("Scoping Paper"), can serve as the basis for developing detailed tariff sheets following a Commission decision and order.[1] To further support the development of detailed tariff sheets, the HECO Companies propose to file draft tariff sheets on January 14, 2009 that

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[1] Separate and apart from this Joint Proposal, the HECO Companies and Consumer Advocate reserve their respective rights to address the Questions posed in the Appendices to the Scoping Paper pursuant to the terms of the Commission's December 11, 2008 letter transmitting the Scoping Paper.

embody these proposed policies and methodologies, in order to facilitate input from the parties to this docket.

I. INTRODUCTION

The Commission's Scoping Paper provides the parties with important guidance in establishing a FIT:

> *Hawaii's geography, electricity infrastructure, retail electricity prices, and general economic conditions set it apart from any other state. The parties must always keep in mind challenges such as high retail electricity prices, the importance of preserving the environment, the lack of interconnectivity between the islands, and challenges concerning the location of generating resources and load when responding to the Commission in this investigation.*

(Scoping Paper at 9)

Moreover, the Scoping Paper expressly notes that:

> *Hawaii already has other mechanisms in place that are designed to encourage the development of renewable resources, including in part: a renewable portfolio standard, the requirement that utilities purchase electricitv from qualifying facilities at avoided cost in compliance with PURPA, net metering for smaller renewable installations, high retail rates and competitive bidding programs for renewable resources.*

(Scoping Paper at 4)

Taken together, the Scoping Paper recognizes and to an extent establishes several fundamental premises of any FIT which are that the FIT design must: (1) account for Hawaii's unique geography and the fact that Hawaii's electric system is comprised of a series of island systems which are not interconnected; (2) be cost effective for ratepayers; (3) appropriately consider and respect environmental issues; (4) insure the operational integrity of each island system and sustain reliability; and (5) recognize that a FIT is but one mechanism to facilitate increased renewable energy for the State among a number of well-established mechanisms as well as mechanisms to be developed such as the PV Host Program described in the HCEI Agreement.

Additionally, it must be recognized that a FIT is generally defined as an offering of a fixed-price contract over a specified term with specified operating conditions to eligible renewable energy generators.[2] A FIT is best suited for renewable energy projects that lend themselves to the use of standardized energy payment rates and power purchase contract terms and conditions, and which can be developed and interconnected to the utility grid in a relatively predictable and systematic manner.

The FIT Proposal attempts to affirmatively address and incorporate each of these central directives and design considerations.

II. DISCUSSION

A. FIT Proposal Framework

"Renewable energy", as defined in Hawaii's renewable portfolio standards statute at Hawaii Revised Statutes ("HRS") §269-91, means energy generated or produced using the following sources:

a. Wind;

b. The sun;

c. Falling water;

d. Biogas, including landfill and sewage-based digester gas;

e. Geothermal;

[2] KEMA *Exploring Feed-in Tariffs for California*. California Energy Commission. Publication No. CEC-00-2008-003-D. Page 4.

f. Ocean water, currents, and waves;

g. Biomass, including biomass crops, agricultural and animal residues and wastes, and municipal solid waste;

h. Biofuels; and

i. Hydrogen produced from renewable sources.

> *Within each of these listed technologies, there may be subsets such as onshore wind versus offshore wind, biomass from varying feedstocks, or project size. A residential rooftop solar PV installation, for example, has a different cost structure than a large-scale solar PV installation. Location may influence the underlying costs of a project (e.g., public land on Oahu versus private land on Kauai). What is the cost and availability of real estate? What is the proximity to transmission and load? Are the underlying cost factors different on different islands for the same technology such as geothermal? <u>These questions and others must inform tariff design</u>.*

(Scoping Paper at 6)(emphasis supplied)

The Commission's Scoping Paper also provides guidance to the parties on how best to integrate these various technologies into a FIT. Specifically, the Scoping Paper recognizes that "the goal of the PBFiT is to encourage the development of <u>certain</u> resources." (Scoping Paper at 12)(emphasis supplied). The Scoping Paper expressly recommends:

> *With probably over a dozen different technologies, some of which require further segmentation by size or location, the number of PBFiTs needed is large. <u>The Commission may wish to focus on PBFiTs that merit priority attention based upon the projects under consideration, or that might be more likely candidates for consideration based upon the existence of a reasonable PBFiT</u>.*

(Id.)

The HECO Companies and the Consumer Advocate agree that initially, the FIT should target those technologies that are actively being developed in Hawaii, and on project types and sizes that are more straightforward to implement and lend themselves to use of standardized energy rates and power purchase contracting. Focusing on these resources will allow the Commission and stakeholders to more readily develop the initial FIT. The HECO Companies and the Consumer Advocate stress that the FIT should be regularly reviewed to encompass more technologies, and propose to do so within two years of the initial FIT, with ongoing reviews every three years thereafter.

Thus, the proposed FIT <u>initially</u> targets renewable resources that:

(1) Do not require complex environmental and land use permitting which may impose significant uncertainties in project development timeframes and costs;

(2) Do not typically, by virtue of their operating characteristics and size relative to the utility system, require extensive and lengthy interconnection studies or the need for significant interconnection requirements;

(3) Utilize technologies for which complex financial accounting issues relative to utility power purchase contracts have already been addressed, and

(4) Have already been, or are currently in the process of being, implemented in Hawaii in commercial (non-R&D) application.

The first criterion refers to environmental permits and review processes including HRS §343 environmental assessments and impact statements, covered source air permitting, and changes in zoning. Each of these processes requires significant time and resources, and approval is at the discretion of the permitting or review agency. Furthermore, potentially costly project modifications may be required by the reviewing agency, which could significantly impact project economics and timing.

Similarly, the second criterion refers to the fact that larger generator sizes and certain technologies will inherently increase the potential for utility grid impacts, and may require more extensive technical review and requirements to safely and reliably interconnect to the utility grid. For example, larger, "central station" generating resources must go through a complex interconnection requirements study ("IRS"). Even "distributed generation" resources interconnecting into distribution circuits may trigger the need for more extensive studies and interconnection requirements. As discussed more fully herein, the proposed FIT adopts the HECO Companies' Interconnection Tariff Rule 14.H to ensure that safety and reliability are not compromised. One of the critical technical issues is the aggregate penetration of generation resources on a distribution circuit. In Rule 14.H, a more extensive interconnection study may be triggered if the aggregate penetration of generation resources on a circuit exceeds 10% of the circuit peak load.

With regard to the third criterion, complex utility accounting issues must be addressed for each type of long-term arrangement the utility enters into. Considerations in the accounting assessments include: the type of fuel source (i.e. sun, wind, waves, biomass), the maturity of the technology, the reliability of the technology, the structure of the payments (i.e. per KWH delivered, per KW available, penalties, bonuses), and the nature of the contract (i.e. firm, as-available, scheduled, etc.). These accounting issues have been addressed for existing and proposed purchased power agreements and certain accounting conclusions are reasonably applied broadly to certain technologies. For example, as-available PV and as-available wind purchased power agreements to date have not resulted in capital lease obligations being recorded on the utility's financial statements. Other technologies which have other characteristics might result in different accounting conclusions. Arrangements which reflect a contract for use of the asset may result in different accounting treatment (e.g. a capital lease obligation being recorded), which may have different financial consequences to the utility. For example, an arrangement that results in a capital lease may impact the financial structure (i.e. debt/total capitalization ratio) of the utility, which could have an impact on the utility's cost of capital. These accounting issues will ultimately be resolved in the course of other Commission proceedings or processes, but the timing of such may not support the desired timeframe to adopt an initial FIT.

Finally, it is the intent of the HECO Companies and the Consumer Advocate to initially prioritize those technologies for which there is already a high degree of demonstrated market desire and development experience in Hawaii. This would be followed shortly thereafter in the first FIT Update by technologies that have been installed elsewhere but have high potential in Hawaii. This is a reasonable approach since the process of establishing reasonable pricing for technologies that are unproven or for which there has been no commercial experience in Hawaii will require more data gathering and consideration.

As discussed in the Scoping Paper "*without credible cost and operating data for a technology, the Commission cannot responsibly establish a PBFiT for that technology.*" (Scoping Paper at 9) Moreover, the Scoping Paper expressly states that:

> *In developing the cost support for a PBFiT, <u>a regulator should examine typical costs and operating characteristics for that type of project, rather than the costs and characteristic of a single particular project using that technology. PBFiTs are meant to encourage reasonable projects (i.e., those that are at least as cost-effective as the typical project) rather than any project regardless of its costs</u>. <u>All cost and operating estimations should, however, be Hawaii-specific</u> to the extent that Hawaii's unique geography affects cost.*

(Scoping Paper at 6)(emphasis supplied)

Applying the criteria above, the HECO Companies and the Consumer Advocate propose that the initial FIT be focused on photovoltaics ("PV"), concentrated solar power ("CSP"), in-line hydropower, and wind, with individual project sizes targeted to provide a greater likelihood of more straightforward interconnection, project implementation and use of standardized energy rates and power purchase contracting. Recognizing that the Commission's December 11, 2008 letter directs the parties to this proceeding to submit cost information for a variety of technologies, it is possible that sufficient information will be provided via this directive that additional technologies may be included in the initial FIT.

B. Summary of Proposal

Attached to this FIT Proposal is a detailed report prepared by HECO's consultant KEMA which provides the background and detail in support of this summary. The KEMA report has been reviewed by the Consumer Advocate.

A FIT will benefit Hawaii when it: (1) facilitates an electric utility's acquisition of renewable energy in a systematic manner; (2) offers a means by which to acquire new renewable energy resources that are reasonable in cost; and (3) does not negatively impact the reliability or unduly encumber the operation or maintenance of Hawaii's unique island electric systems. Key elements of the FIT Proposal are as follows:

1. An Interim Design Followed by Regular Updates

The FIT Proposal is intended as an interim starting point for what will eventually become a broad tariff offering to as many renewable technologies as is feasible. For the reasons described in more detail below, the proposed FIT initially focuses on a subset of technologies and projects. The FIT will be regularly reviewed for the purpose of updating tariff pricing, applicable technologies, project sizes, and annual targets ("FIT Update"). A FIT Update will be conducted for all islands in the HECO Companies' service territory not later than two years after initial implementation of the FIT. Thereafter, the FIT Update will be conducted every three years.

As described above, the FIT Proposal initially targets renewable resources that (1) do not require complex environmental and land use permitting which may impose significant uncertainties in project development timeframes and costs; (2) do not typically, by virtue of their operating characteristics and size relative to the utility system, require extensive and lengthy interconnection studies or the need for significant interconnection requirements; (3) utilize technologies for which complex financial accounting issues relative to utility power purchase contracts have already been addressed, and (4) have already been, or are currently in the process of being, implemented in Hawaii in commercial (non-R&D) application.

The HECO Companies and the Consumer Advocate would consider additional technologies for the initial FIT as well as modifications to the proposed size targets, if information justifying such is provided by the other parties to this proceeding. The initial target project sizes are based on utility system integration considerations, current market activity, and also consider consistency with other regulatory mechanisms and initiatives such as Schedule Q, the Net Energy Metering Pilot Program ordered by the Commission in Docket No. 2006-0084, and provisions of the HECO Companies' Tariff Rule 14.H governing interconnection of distributed generation.

a. PV systems up to and including 500 kW[3] in size on Oahu, PV systems up

[3] Throughout this document, "kW" means kilowatts alternating current net to grid. The 500 kW figure is consistent with the upper range of the NEM Pilot directed by the Commission in Docket No. 2006-0084. The larger size on Oahu recognizes that there will be fewer cumulative system impacts on the HECO grid compared to the other islands. Project-specific interconnection requirements will be identified via the HECO Companies' Rule 14.H interconnection tariff.

to and including 250 kW[4] on Maui and Hawaii Island, and PV systems up to and including 100 kW[5] in size on Lanai and Molokai.

b. CSP systems up to and including 500 kW[6] in size on Oahu, Maui, and Hawaii Island, and up to and including 100 kW on Lanai and Molokai.

c. In-line hydropower systems up to and including 100 kW[7] in size on Oahu, Maui, Lanai, Molokai, and Hawaii Island.

d. Wind power systems up to and including 100 kW[8] in size on Oahu, Maui, Lanai, Molokai, and Hawaii Island.

The following additional technologies will be given priority consideration in the first FIT Update, given their demonstrated use in other jurisdictions and the high degree of interest in developing these resources in Hawaii:

a. Wave energy generating systems.

b. Landfill gas generating systems.

c. Sewage-based digester gas generating systems.

d. Biomass, including biomass crops, agricultural and animal wastes, and municipal solid waste.

e. Liquid biofuel-fired systems.

Annual FIT quantity targets will be established and regularly updated in the course of the FIT Update process. The annual quantity targets will be based on both technical and non-technical factors, considering among other things:

a. Renewable portfolio standards requirements.

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[4] Rule 14.H allows for expedited review of systems up to this size provided distribution circuit penetration is not greater than 10%. If penetration is above this, then additional interconnection requirements may apply such as Supervisory Control and Data Acquisition (SCADA) and Direct Transfer Trip (DTT).

[5] The lower figure is due to the much smaller grids on these islands. This is also consistent with existing Schedule Q levels.

[6] This is based upon the size of a system currently being installed on the Big Island.

[7] This is consistent with Schedule Q.

[8] This is consistent with Schedule Q.

b. The goals of the Hawaii Clean Energy Initiative ("HCEI").

c. Technical attributes of the resources.

d. Characteristics of the utility systems being interconnected to.

e. Cumulative amounts of installed intermittent resources.

f. Impacts on curtailment of as-available energy from existing resources.

g. Projected energy production levels.

h. Ratepayer impacts.

i. Impacts on utility credit ratings.

j. Administrative resource requirements.

k. Other policy goals including the desire to provide fair opportunity to multiple developers or to encourage development of certain market segments, for example, residential and small commercial PV.

The proposed targets are consistent with the directives contained in the Commission's Scoping Paper:

> *Overall caps on the amount of electricity purchased under PEFiTs are reasonable to consider, as the above-market price paid for electricity under a PEFiT places upward pressure on the retail price for electricity. *** A regulator may want to consider the total impact the Clean Energy Infrastructure Surcharge (CEIS) has on retail rates, not just the impact of the PBFiT purchases when setting a cap. Caps could be set so that when a utility meets its RPS goal, PEFiTs are not available to additional projects. Caps can also be placed on installed capacity, expected production, or rate impact (e.g., the difference between the purchased cost made under a PEFiT rate and an avoided-cost rate compared to total retail revenues).*

(Scoping Paper at 8)

2. <u>Tariff Pricing Consistent with the Parties' Inputs</u>

The Scoping Paper suggests that the Commission "*make clear to all parties that without credible cost and operating data for a technology, the Commission cannot responsibly establish* *a PBFiT for that technology*." (Scoping Paper at 9) Additionally, and as referenced above, the Scoping Paper directs that:

> *In developing the cost support for a PBFiT, a regulator should examine typical costs and operating characteristics for that type of project, rather than the costs and characteristic of a single particular project using that technology. PBFiTs are meant to encourage reasonable projects (i.e., those that are at least as cost-effective as the typical project) rather than any project regardless of its costs. All cost and operating estimations should, however, be Hawaii-specific to the extent that Hawaii's unique geography affects cost.*

(Scoping Paper at 6)

The Scoping Paper also discusses the fact that the "*Commission must receive from the parties, <u>especially developers</u>, and assess for accuracy estimates of the typical cost of each technology if capital is to be efficiently attracted and extra costs are not to be borne by customers*." (Scoping Paper at 5)(emphasis supplied) Accordingly, no specific tariff pricing is proposed at this time, as the HECO Companies and Consumer Advocate intend to utilize the data received in response to the Scoping Paper's request for cost information, as well as parties' responses to the questions in Appendix C to develop more accurate and geographically relevant tariff pricing. The HECO Companies and the Consumer Advocate, as stated in the HCEI Agreement, support FIT rates that are designed to cover the producer's costs of energy production plus reasonable profit.

Furthermore, the HECO Companies and the Consumer Advocate agree that tariff pricing should differentiate between technology type, project size, and location, and should be based on the costs of developing a "typical" project that is reasonably cost-effective. In this manner, the FIT payment rates will not encourage development of generation that is not cost-effective, consistent with the Commission's policy on distributed generation stated in Decision and Order No. 22248 in Docket No. 03-0371. Generally, project cost-based energy payment rates are established based on a target internal rate of return ("IRR"), knowledge of project and generation cost information, and energy production. Ultimately, the Commission must make a determination as to an acceptable target IRR.

Additionally, any base tariff rate should appropriately compensate renewable resources for the reliability benefits that are provided to ratepayers. A base tariff rate by technology will be paid to generation projects that provide system reliability benefits such as being utility dispatchable or curtailable, or have low-voltage/low-frequency ride-through capabilities. The base FIT will be adjusted downwards for renewable energy systems that do not have these features, if allowable from a system integration perspective.

The HECO Companies and the Consumer Advocate propose that FIT pricing be reviewed in the course of the FIT Update, and that an independent consultant be used to compile information and make recommendations on assumptions for the costs of generation and energy production levels. The Commission must also issue a determination concerning the ability to establish FIT energy payment rates above avoided cost.

3. <u>Contract Terms Consistent With The Industry-Standard</u>

As stated in the Scoping Paper, *"[r]egulators must determine based upon information provided by the parties, especially developers, the term of a PBFiT before it is possible to determine the PBFiT's price."* (Scoping Paper at 9) Development of proposed term lengths for FIT contracts will consider (1) industry-standard assumptions on service life, and (2) recent contracting experience. A 20 year term for PV systems and a 10 year term for CSP are proposed preliminarily. Additional information is being gathered for in-line hydropower and small scale wind. Following the initial term, projects will be allowed to extend on a year by year basis, subject to a new FIT energy payment rate.

4. Utilize A Well Established Interconnection Process

The proposed FIT operates in conjunction with the HECO Companies' interconnection review processes and tariff, known as Tariff Rule 14.H. All provisions for expedited interconnection review that are currently in Rule 14.H will be retained. For example, Tariff Rule 14.H provides for expedited interconnection review of inverter-based (e.g., PV) systems up to 250 kW assuming there are no issues with distribution circuit penetration levels. Provisions under Rule 18 Net Energy Metering which allow streamlined review for PV systems of 10 kW and smaller will be reviewed and retained to the extent possible, considering that all power generated is exported to the utility grid under a FIT.

In general, FIT generators will continue to be responsible for the costs of interconnection to the HECO Companies' grids, in conformance with the HECO Companies' Rule 14.H interconnection requirements and processes and the Commission's Decision and Order No. 22248 in the Distributed Generation Investigative Docket No. 03-0371. However, in keeping with the intent of the FIT, reasonable FIT generator interconnection costs, including costs of interconnection studies and modifications to the utility system, will be assumed in the establishment of FIT payment rates for different generator categories. For example, for generators less than 10kW, minimal interconnection costs will be assumed, whereas for larger FIT generators in the 250kW to 500kW range, a reasonable allowance for costs of interconnection will be incorporated in the FIT payment rate for that generator size range.[9]

[9] The existing practice of requiring the generator owner to pay for the cost of interconnection will be retained, however the generator owner will be compensated via the FIT energy payment rate. The FIT energy payment rate will assume a "typical" cost of interconnection for technologies, differentiated by technology and size.

Consistent with the provisions of the HCEI Agreement, the HECO Companies may choose to implement modifications on the utility system side of the point of interconnection to facilitate distributed energy resource utilization beyond an individual FIT installation, the costs of which will be recovered through the Clean Energy Infrastructure Surcharge and later placed in rate base in the course of the next rate case proceeding.

5. Interaction Of The FIT With Net Energy Metering

Pursuant to the objectives stated in the HCEI Agreement, the HECO Companies and the Consumer Advocate recommend that no applications for new net energy metering contracts will be accepted once the FIT is formally made available to customers.[10] All net energy metering systems under contract or contracts in the process of utility review at the time the FIT is formally made available to customers will be grandfathered. Such grandfathering would apply for the life of the net energy metered system, meaning changes in ownership of net energy metered systems will be allowed. Expansion of net energy metering system capacity will not be allowed once the FIT is established. Installation of additional generation at a site will be treated as a separate system, eligible for the FIT or a negotiated power purchase agreement. Net energy metering customers may opt-in to the FIT at any time, subject to a different tier of energy pricing and shorter contract term.

6. Interaction Of The FIT With Schedule Q

The HECO Companies and the Consumer Advocate propose that no applications for new Schedule Q contracts will be accepted once a FIT is formally made available for the resource

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[10] The HECO Companies and the Consumer Advocate recognize that net energy metering is required by statute, and that potential statutory changes may be necessary to implement this recommendation.

type. Schedule Q will continue as an option for qualifying projects of 100 kW and less for which a FIT is not available.[11] All Schedule Q systems under contract, or contracts in the process of utility review at the time the FIT is formally made available to customers will be grandfathered through the term of their Schedule Q Agreement. The HECO Companies will not initiate termination of such contracts. Expansion of capacity to a Schedule Q system will not be allowed once the FIT is established. Installation of additional generation at a site will be treated as a separate system, eligible for the FIT or a negotiated power purchase agreement. Schedule Q customers may opt-in to the FIT at any time, provided that the remaining useful life of the system is at least as much as an available FIT term.

7. The Framework for Competitive Bidding Remains in Place

The Framework for Competitive Bidding will remain unchanged. Competitive bidding is the most appropriate mechanism to manage the acquisition of larger scale resources that have higher potential for material policy, economic, and system planning and operation issues. The targeted project sizes of the FIT Proposal are less than the minimum project size thresholds of the Commission's Framework for Competitive Bidding, adopted December 8, 2006 in Docket No. 03-0372. The Framework for Competitive Bidding does not apply to generating units with a net output available to the utility of 1% or less of a utility's total firm capacity, including that of independent power producers, or with a net output of 5 MW or less, whichever is lower. (Framework for Competitive Bidding, page 5)

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[11] The HECO Companies and the Consumer Advocate recognize the Commission's order suspending the Schedule Q Docket, in light of the development of the FIT. Although the Schedule Q Docket has been suspended, Schedule Q remains an available tariff to eligible generators. Schedule Q generators currently under contract consist only of in-line hydro and small scale wind resources, which are included in the initial set of proposed FIT technologies.

8. Reasonable Credit and Performance Assurance Provisions

The FIT Proposal includes credit performance and assurance provisions to ensure that speculative projects do not tie up available capacity under the annual capacity targets for the feed-in tariff. Specifically, it is proposed that a reasonable, refundable application fee be assessed when a generator applies for a feed-in tariff. The refundable fee would be set on dollar per kW basis to differentiate by project size. The application fee would be refunded once the generating project begins operating. However, the application fee, and the generator's place in the feed-in tariff queue, would be lost should project development not be completed within specified timelines.

III. CONCLUSION

Consistent with the Commission's Scoping Paper, the FIT Proposal is intended as an interim starting point for what will eventually become a simple, streamlined and broad tariff offering to as many renewable technologies as is feasible while also allowing for the effective and reliable delivery of electrical service. For the reasons described herein, the FIT Proposal initially focuses on a subset of technologies and projects. The FIT will be regularly reviewed for the purpose of updating tariff pricing, applicable technologies, project sizes, and annual targets through the FIT Update. A FIT Update will be conducted for all islands in the HECO Companies' service territory not later than two years after initial implementation of the FIT. Thereafter, the FIT Update will be conducted every three years.

The HECO Companies and Consumer Advocate look forward to further discussions of the FIT Proposal with the parties and the Commission and toward a cooperative dialog regarding the development of a FIT design consistent with the principles outlined in the Commission's Scoping Paper.

Dated: Honolulu, Hawaii, December 23, 2008.

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KEMA

HECO Feed-In Tariff Program Plan

Prepared by KEMA for Hawaiian Electric Company, Inc.

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December 23, 2008

KEMA

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1. Introduction

KEMA is pleased to submit this report to the Hawaiian Electric Company, Inc. ("HECO") and its subsidiaries Maui Electric Company, Ltd. ("MECO") and Hawaii Electric Light Company, Inc. ("HELCO", together, the "HECO Companies") to support the development of their joint Proposal on Feed-In Tariffs ("FIT Proposal") with the Division of Consumer Advocacy, Department of Commerce and Consumer Affairs (the "Consumer Advocate").

Feed-In Tariffs (FITs) have driven rapid renewable energy market growth internationally and have created empirical benefits for countries that have designed them effectively. Based on international experience to date, the potential benefits of a feed-in tariff policy include:

- Rapid renewable energy market growth: The world's leading wind energy and solar energy markets, such as Germany and Spain, have relied on FITs to rapidly expand their installed renewable energy capacity. At the end of 2007, Germany and Spain had installed a total of 37,768 MW of wind power, or 2.5 times more capacity than the United States.[1] This is particularly remarkable since Spain and Germany represent only 9.2 percent of total U.S. landmass combined. Both countries have also rapidly expanded the share of renewable energy in their portfolios. Germany, for example, expanded its share of renewable electricity from approximately 6 percent in 2000 to over 14 percent in 2007, reaching its 2010 goal of 12.5 percent three years ahead of schedule.

- Reduction of project developer costs, risks, and complexity without significantly increasing ratepayer cost: FITs reduce developer cost and risk because they are standard offers available to generators without the need for potentially lengthy and costly competitive processes. The simplicity and lower transaction costs of FITs lowers the cost of project

[1] European Wind Energy Association. (2008). Wind map 2007. Retrieved August 8, 2008, from http://www.ewea.org/fileadmin/ewea_documents/mailing/windmap-08g.pdf *See also* Bundesverband Solarwirtschaft. (2008). *Statistische Zahlen der deutschen Photovoltaikbranche*. Berlin, Germany; American Wind Energy Association (2008). AWEA Wind Power Projects Database. Retrieved December 20, 2008 from http://www.awea.org/projects/.

development, reduces the rate of contract failure,[2] and also increases the ability for small businesses and small projects to develop renewable energy systems.

- Reduction of investor risk and policy cost: By basing incentive levels on the cost of generation plus a reasonable return, FITs create a high degree of investor security. By lowering investor risk, FITs also lower financing costs, and therefore reduce policy costs. A recent International Energy Agency analysis found that policies that reduce investor risk, such as FITs, can be 10 percent-30 percent less costly than other policy types.[3] Analyses from both Europe and the U.S. have also concluded that FITs have a comparatively lower cost than policy types that employ riskier competitive mechanisms such as tradable credits.[4] In Hawaii, FITs based on generation cost may also generate savings since generation costs for certain technologies may be below current avoided cost levels.

- Economic development and job creation. Renewable energy creates more jobs than other energy industries and also has a higher multiplier impact on local economies than does conventional energy development.[5] To the extent that FITs can drive renewable energy development more rapidly than other policy types, these local job creation benefits can be achieved on a quicker timescale. Germany, for example, employed over 250,000 in the renewable energy industry in 2007, an increase of more than 90,000 jobs since 2004.

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[2] Wiser, R., O'Connell, R., Bolinger, M., Grace, R., & Pletka, R. (2006). *Building a "margin of safety" into renewable energy procurements: A review of experience with contract failure* (CEC-300-2006-004). Sacramento, CA: California Energy Commission.

[3] de Jager, D., & Rathmann, M. (2008). *Policy instrument design to reduce financing costs in renewable energy technology projects*. Utrecht, the Netherlands: Ecofys International BV. Prepared for the International Energy Agency, Renewable Energy Technology Development

[4] Commission of the European Communities. (2005). *The support of electricity from renewable energy sources*. Brussels: Commission of the European Communities; *see also* Summit Blue Consulting, & Rocky Mountain Institute. (2007). *An analysis of potential ratepayer impact of alternatives for transitioning the New Jersey solar market from rebates to market-based incentives* (Final Report). Boulder, CO: Summit Blue Consulting. Prepared for the New Jersey Board of Public Utilities, Office of Clean Energy

[5] Pollin, R. (2008). *Testimony before House Committee on Education and Labor Hearing on "Building an Economic Recovery Package: Creating and Preserving Jobs in America", October 24, 2008*. Amherst, MA: University of Massachusetts-Amherst, Political Economy Research Institute (PERI); Kammen, D., Kapadia, K., & Fripp, M. (2004). *Putting renewables to work: How many jobs can the clean energy industry generate?* Berkeley, CA: University of California, Berkeley, Renewable and Appropriate Energy Laboratory

- Targeted technology development and innovation. Generation cost-based FITs can be used to target specific types of renewable energy development. In Germany, FITs are used to support innovative technologies such as Sterling engines and organic Rankine cycles, for example, whereas the proposed feed-in tariff in Minnesota would support community owned projects. Hawaii has an opportunity to develop unique FITs that would simultaneously support renewable energy development and grid integration technologies. FITs for intermittent resources coupled with expanded under-frequency ride through capability, for example, would allow Hawaii to move more quickly towards its ambitious long-term portfolio goals. Hawaii would also be well positioned to export innovative grid integration strategies as other states and countries reach higher renewables penetration levels in the future.

As elaborated in the Hawaii Clean Energy Initiative (HCEI) Agreement, FITs provide a mechanism to stimulate renewable energy development by providing predictability and certainty with respect to the future prices to be paid for renewable energy. The HCEI Agreement also states the following:

> As we move from central-station, oil-based firm power to a much more renewable and distributed and intermittent powered system, we accept that the operating risks of the Hawaiian Electric Companies will increase which may potentially affect customers. Thus, we recognize the need to assure that Hawaii preserves a stable electric grid to minimize disruption to service quality and reliability. In addition, we recognize the need for a financially sound electric utility. Both are vital components for our achievement of an independent renewable energy future.
>
> We commit to take steps to reduce the demand for electricity and increase the efficiency of energy that we do use both to reduce the costs to the public and to reduce the level of electrical generation. At the same time, we recognize that a system of utility regulation will be needed to assure that Hawaii preserves a stable electric grid and a financially sound electric utility as vital components of our renewable energy future.

Consistent with the HCEI agreement, the FIT Proposal is intended to expand the amount of renewable energy on the HECO Companies' systems in conjunction with other mechanisms, and ultimately replace net metering and the HECO Companies' Schedule Q tariffs. By also setting rates at the cost of technology (plus profit), the FIT will delink costs paid to generators from the HECO Companies' avoided cost which is presently primarily linked to fossil fuel generation, also a goal of the HCEI Agreement.

The FIT Proposal is also mindful of the unique circumstances of each of the island grids in Hawaii. Technical issues must be addressed appropriately in the design of the FIT to ensure that system reliability is maintained. For example, there are presently system frequency management challenges due to the variability of wind generation, and curtailment of excess renewable energy production on the HELCO and MECO systems. For all three power systems, the technical challenges associated with integration of variable generation increase as the grid penetration level increases, and are also affected by unique power system characteristics such as utility system size and existing available generation resources.

2. Policy Overview

The State of Hawaii relies on fossil fuels to supply more than 90 percent of its energy needs. As a result, Hawaii has some of the highest per kWh electricity rates and transportation costs in the nation. The State also has an abundance of natural energy resources such as wind and solar to geothermal and energy crops, from which electricity can be produced. Development of certain types of renewable energy resources is already occurring at the State, county, utility, and private sector levels. In fact, the HECO Companies already have significant levels of these types of renewable energy resources and distributed generation on their systems throughout the islands. Further additions of these and other types of renewable resources, however, must be done in a manner that maintains system reliability and serves the interests of Hawaii ratepayers.

2.1 Hawaii Clean Energy Initiative (HCEI)

On January 28, 2008, the U.S. Department of Energy ("DOE")and the State of Hawaii signed a Memorandum of Understanding ("MOU") establishing a long-term partnership between the two entities to transform the way in which renewable energy and energy efficiency resources are planned for and used in the State. The partnership aims to have 70 percent of all of Hawaii's energy needs generated by renewable energy sources by 2030.

The Partnership is structured in such a way as to build upon the ongoing work of public and private organizations at the State, county and grassroots levels.

The five goals of the HCEI, listed below, were outlined in the MOU.

1. Define the structural transformation that will need to occur to transition the State to a clean energy dominated economy.
2. Demonstrate and foster innovation in the use of clean energy technologies, financing methodologies, and enabling policies designed to accelerate social, economic and political acceptance of a clean energy dominated economy.
3. Create opportunity at all levels of society that ensures wide-spread distribution of the benefits resulting from the transition to a clean, sustainable energy State.
4. Establish an "open source" learning model for others seeking to achieve similar goals.
5. Build the workforce with crosscutting skills to enable and support a clean energy economy.

To achieve the goals outlined in the HCEI, the State and DOE agreed to work together through working groups and through a dedicated Policy and Regulatory Team to:

1. Establish short-, medium- and long-term clean energy deployment plans;
2. Institutionalize the financial, policy and regulatory mechanisms needed to transition to a clean energy future; and
3. Communicate the goals, benefits and accomplishments of the partnership with the citizens of Hawaii, the United States, and the Pacific Rim.

In April 2008, the DOE-sponsored Policy and Regulatory team conducted a series of trainings for the Public Utilities Commission ("Commission"), the Department of Business, Economic Development and Tourism ("DBEDT"), the Consumer Advocate, the Hawaiian Electric Companies and various stakeholders. The purpose of the trainings was to gain insight from the participants on the current conditions in the State, identify sustainable energy solutions for Hawaii, help define the future path of the electric sector, and begin the development of a clean energy work plan.

At the end of the weeklong training sessions, the Commission charged the Policy and Regulatory Team with drafting a Strawman Regulatory Framework for meeting the 70 percent by 2030 clean energy objective outlined in the HCEI. The Strawman was submitted to the Commission in June 2008 and served as the basis for the October, 2008, HCEI Agreement between the State of Hawaii, the Consumer Advocate, DBEDT, and HECO.

The HCEI Agreement summarizes the objective of the policies developed under the Hawaii Clean Energy Initiative as follows:

> The economic and culturally sensitive use of natural resources to achieve energy supply security and price stability for the people of Hawaii, as well as significant environmental and economic opportunities and benefits.

With regard to FITs, the Parties to the HCEI Agreement agree that FITs are "beneficial for the development of renewable energy, as they provide predictability and certainty with respect to future prices to be paid for renewable energy and how much of such energy the utility will acquire."[6] The Parties to the HCEI Agreement further request that the Commission conclude an investigative proceeding on FIT design by March 2009. The Parties to the HCEI Agreement also ask the Commission to adopt a set of FITs and prices by July 2009 based on the outcomes of the FIT investigation.

[6] Hawaii Clean Energy Initiative Agreement, page 16.

2.2 The Hawaii Renewable Portfolio Standard (RPS)

The current version of the Hawaii RPS calls for each electric utility company to procure 20 percent of its net electricity sales from renewable electrical energy by 2020, with interim stepping stones of 10 percent by 2010 and 15 percent by 2015. In meeting these goals, utilities may count existing renewable generating facilities and energy efficiency and energy displacement technologies towards the targets. In addition, the HECO Companies may aggregate their renewable portfolios to achieve the overall target.

In 2007, the HECO Companies procured 16.1 percent of their electricity portfolio from eligible RPS resources, an increase from the 13.8 percent achieved in 2006. This increase was achieved through demand side management programs and the addition of three new wind farms.

Although the HECO Companies have made progress towards the RPS goals, the HCEI Agreement proposes changes to the RPS framework that will require significant additions to the amount of renewable capacity installed within the State. These changes include an increase in the RPS target to 40 percent by 2030, and a requirement that energy efficiency and renewable displacement technologies no longer be eligible for RPS compliance starting in 2014. A FIT would provide an additional mechanism to meet RPS targets under these new parameters.

The HCEI Agreement is clear that renewable energy procured using a FIT would be counted towards the state RPS goals. As described below, the proposed FIT targets smaller generators, and it is envisioned that competitive solicitations would still be used for larger project sizes. There are many instances across the U.S. and around the world where different mechanisms are used to support different types of resources to achieve an overarching renewables target. Many of the RPS "carve-outs" currently in place in the U.S., for example, rely on separate incentives than the main RPS tiers. New Jersey, for example, relies on tradable credits for both its main and solar tiers, although it recently considered a mechanism similar to a feed-in tariff for its solar tier. New York uses a competitive solicitation for its main tier, and rebates for its distributed generation tier. Internationally, Italy and the UK both use tradable credits for their main resource tier, but now use feed-in tariffs for their PV and small-scale generation carve-outs, respectively.

3. FIT Program Design Overview

This section provides a high level outline of the proposed FIT design for the HECO Companies. The initial FIT is proposed to target technologies for which there is a relatively established experience base in Hawaii, with additional technologies to be added within two years. Furthermore, the FIT is proposed to operate in conjunction with other utility mechanisms for acquiring renewable energy, such as the Competitive Bidding framework, targeting those resources that might not be as effectively accommodated by those processes . FIT rates will be based on the cost of generation plus reasonable profit, with a base rate established for projects with grid-friendly features such as low-frequency ride through and the ability to be curtailed, and lower rates for projects without these grid-friendly features.

To manage technical, economic, and policy objectives, as well as tariff administration requirements, annual system quantity targets will be established for each island utility, differentiated by technology type. The HECO Companies have commissioned KEMA to assist in setting a methodology for imposing annual system quantity targets.

More details are provided in the remainder of this section, which is divided into the following subsections: (1) policy and design objectives; (2) proposed FIT and other renewable resource acquisition mechanisms; (3) phased approach and the FIT update process; (4) eligibility; (5) setting the FIT rate; (6) quantity targets; (7) interconnection; (8) queuing; (9) contract duration; (10) cost allocation; (11) credit performance and assurance; and (12) implementation issues for further consideration.

3.1 Policy and Design Objectives of the Proposed FIT

A FIT can be defined as a fixed-price contract for renewable electricity from eligible generators. Recognizing the unique technical characteristics of Hawaii's isolated island grid systems, the current high cost of electricity, and the desire to establish a FIT system that is efficient, a FIT will benefit Hawaii when it achieves the following policy objectives:

1. Facilitates an electric utility's acquisition of renewable energy in a systematic manner;
2. Offers a means by which to acquire new renewable energy resources that are reasonable in cost; and
3. Does not negatively impact the reliability or unduly encumber the operation or maintenance of Hawaii's unique island electric systems.

There are a number of design elements to a FIT that will vary depending on the specific policy objectives that a jurisdiction is trying to achieve. Thus, in drafting the FIT Proposal, KEMA recognizes that both the HECO Companies and the Hawaii Consumer Advocate are highly motivated by the following design objectives:

- Accelerate the addition of renewable energy to produce a diversified portfolio of renewable resources and maximize renewable penetration, taking into account differences between the islands and technology types;
- Maintain system reliability, grid stability and safety standards;
- Provide reasonable incentives to cost-effective renewable energy providers while minimizing costs to ratepayers;
- Complement existing Hawaii policy framework as much as possible and target gaps in the current renewable energy policy framework;
- Stabilize electric rates over time;
- Provide predictability and certainty to renewable project developers, regulators, and the utility; and
- Strive for simplicity as much as possible.

3.2 Proposed FIT and Other Renewable Resource Acquisition Mechanisms

The FIT is proposed to complement other mechanisms to acquire renewable energy, out of recognition that these mechanisms may be more appropriate in targeting development of certain resources. For example, larger dispatchable resources or technologies requiring large economies of scale (e.g., waste-to-energy) are more effectively encouraged and developed using the PUC's Framework for Competitive Bidding. Therefore the proposed FIT targets smaller scale resources.

The FIT mechanism is also intended to support predictability and streamlining in pricing, contracting, and project development, to the benefit of both renewable energy producers and ratepayers. Therefore the FIT initially targets those projects for which Hawaii-specific costs and technical requirements are better understood and can be established in the near term. Other resources for which a FIT is not immediately available can be contracted on a one-off basis with the utility under existing processes.

Thus, the FIT is best considered as a one of several renewable resource acquisition mechanisms that operate in parallel, with the FIT specifically targeted at distributed resources for which there is a suitable experience base in Hawaii. The FIT will complement (1) the Framework for Competitive Bidding, (2) negotiated power purchase agreements, and (3) the PV

Host Program to be developed by the HECO Companies. In addition, site owners will continue to be able to develop on-site generation systems to serve on-site power needs.

3.2.1 Framework for Competitive Bidding

The Framework for Competitive Bidding is proposed to remain unchanged. In the view of the HECO Companies and the Consumer Advocate, competitive bidding is the most appropriate mechanism to manage the acquisition of larger scale resources that individually have higher potential for material policy, economic, and system planning and operation issues. Therefore, the targeted project sizes of the initial FIT are at the distributed generation level, below the minimum project size thresholds of the Commission's Framework for Competitive Bidding, adopted December 8, 2006 in Docket No. 03-0372.[7]

3.2.2 Negotiated Power Purchase Agreements

Sale of as-available energy to the HECO Companies will not be required to be done via the FIT and may be contracted on a negotiated power purchase agreement basis, provided that the HECO Companies will not be required to offer pricing, terms, and conditions for such power purchase agreements that are the same as under the FIT, nor follow the same contract processing and technical review procedures established for the FIT.[8] In establishing the FIT pricing and program design, the HECO Companies will encourage development of eligible resources to come in via the FIT in pursuit of the policy objective of encouraging systematic development of renewable resources.

3.2.3 PV Host Program

In accordance with the HCEI Agreement, the HECO Companies will file an application to the Commission by March 31, 2009, to establish a program referred to as the "PV Host" program. As described in the HCEI Agreement, under the PV Host program concept the HECO

[7] The Framework for Competitive Bidding does not apply to generating units with a net output available to the utility of 1 percent or less of a utility's total firm capacity, including that of independent power producers, or with a net output of 5 MW or less, whichever is lower.

[8] As an example, the proposed FIT requires compliance with the HECO Companies' Rule 14.H interconnection tariff (see Section 3.7), which sets forth procedural guidelines and requirements and standardized interconnection agreement terms and conditions. Negotiated power purchase contracts undergo individual interconnection requirements studies and development of contract-specific terms and conditions.

Companies will contract for use of customer sites, and will competitively procure PV systems to be developed at these sites. As consideration for use of the site, the site owner would receive a site rental payment and/or use of a portion of the PV energy generated at their site. The PV Host program will primarily focus on development of systems at sites that can provide beneficial economies of scale and administrative efficiencies, such as large sites or multiple sites owned by a single entity such as a government agency.

The HCEI Agreement allows for the PV systems under PV Host to be either third party or utility owned. The HECO Companies intend to rely on third party-owned systems to the greatest extent possible, in which case the utility will purchase PV energy from the third party owner under a PV Host energy purchase agreement. The PV Host energy purchase rate is intended to be standardized and established in much the same way as the FIT energy purchase rate. The HECO Companies will consider the methodologies developed for the FIT rates as they develop the PV Host proposal.

3.2.4 On-site Generation Without Export of Power to Utility Grid

Site owners will continue to have the ability to install power generating systems to serve their on-site loads without export to the utility grid, independent of the FIT. If feasible, site owners may install systems to serve on-site loads and separate systems to provide energy for sale to the utility via the FIT or a negotiated power purchase agreement. All systems operated in parallel to the utility system must comply with the HECO Companies' Rule 14.H interconnection tariff.

3.2.5 FIT as a Replacement for Net Energy Metering and Schedule Q

As described in detail in Section 3.4, the proposed FIT initially targets distributed resource types and sizes which are currently encompassed by the existing net energy metering and Schedule Q tariffs. As stated in the HCEI Agreement, net energy metering ("NEM") serves as an interim measure to encourage the installation of and payment for renewable energy generated from customer-sited systems, generally PV systems. The intent of the HCEI Agreement is that NEM will be replaced by the FIT. An appropriately priced FIT is preferable from a broad ratepayer perspective since NEM customers, by receiving credit at the full retail rate, essentially receive a subsidy from all other customers.

FITs may also be preferable to site owners over NEM for the following reasons:

- Retail rates are subject to fluctuation, such as due to the rise and fall of oil prices, and vary depending on the type of customer (Schedule P, Schedule J, Schedule R, etc.). Thus, the benefits of NEM differ for each customer and may at times be marginal for some. Feed in tariffs offer a predictable return on investment without volatility of retail pricing of electricity.

- The FIT generator is paid a stabilized rate for all of the electricity fed to the grid. There is no annual "true-up" at the end of the year where the NEM customer might forfeit unused NEM credit.

- The FIT provides an incentive for customer-generators to make full use of their sites to generate energy to sell to the electric utility. Under NEM, customer renewable generating systems are sized mainly to serve on-site customer loads, with minimal excess power exported to the grid.

- Under NEM, there is little incentive provided to building owners who lease their facilities out, as the building owners are not large users of the electricity. The tenants of the building, the electric consumers, are not incented to install renewable generation under NEM since they do not own the facility. A FIT provides an option for site owners to install renewable generation, whether or not they use electricity at the site. Furthermore the site owner is not subject to risk of vacancy, since all power produced will be bought by the utility.

- NEM is not applicable to development of renewables at green-field sites where there is no electric load. A FIT provides an efficient mechanism for owners of vacant land to develop renewables.

The proposed FIT is also preferable over Schedule Q from an energy policy perspective. A goal of the HCEI agreement is to delink energy payment rates in all new renewable energy contracts from fossil fuel costs.[9] Schedule Q rates are tied to the HECO Companies' short run avoided costs, which are linked to the cost of oil.

[9] HCEI Agreement, Section 6.

3.3 Phased Approach to FIT Development and FIT Update Process

HELCO and MECO have significant levels of renewable energy and distributed generation on their systems, and curtailment of generation is already occurring on some of the islands. In addition, some islands do not need additional capacity and there are concerns about adding more generation capacity while maintaining system reliability.[10] The Consumer Advocate wants to ensure that the prices set forth in the FIT are reasonable, especially given the high per kWh rates that are currently authorized by the Commission.

Given these considerations and the objectives listed in Section 3.1, a phased approach is recommended where the initial FIT establishes rates for technologies that are known and established in Hawaii, with periodic review and update of the initial FIT to review the initial rates and adjust as necessary, and to establish rates for additional renewable energy technologies that may not have been included in the initial tariff due to lack of available data for such technologies.

The first FIT review and update is proposed to be conducted for all islands in the HECO Companies' service territory two years after initial implementation of the FIT, with subsequent FIT updates occurring every three years thereafter. The accelerated two year interval for conducting the first FIT review and update was deemed desirable and reasonable for the following reasons:

- A two year period is believed to provide sufficient time for the market to respond to the FIT that is initially established and provide data as to whether the established rates and processes are achieving the objectives of establishing the FIT.
- If the rates and processes that are initially established are not achieving the stated objectives, adjustments could be made in a timely manner.

[10] For the HECO system, additional quick start capacity may be needed to counteract additional renewable technology to minimize impact to reliability. The concern is adding more as-available generation during the off-peak times and having to manage curtailment. Having more as-available generation during the off-peak will push HECO's system to the edge and require turning off large inertia machines that are needed to follow load and regulate the frequency.

- The interval would allow for the timely establishment of additional technologies that may not have been previously considered, but have subsequently developed as proven technologies.
- The initial locational value maps of the Clean Energy Scenario Planning ("CESP") process are expected to be completed within the next two years.

The periodic FIT updates will also include review of the annual system quantity targets described in Section 3.6, in addition to considering energy payment rates and adding technologies.

If the FIT rate for a particular technology is revised as a result of the FIT Update, the renewable energy provider will be compensated at the rate that was in effect at the time the PPA was executed, for the term of the PPA contract.

3.4 Eligibility

3.4.1 Types and Sizes of Generation

Ultimately, all renewable electricity generating technologies that are eligible under the Hawaii RPS may be eligible for the FIT. However, energy efficiency and electricity displacement technologies, also eligible under the Hawaii RPS, will not be eligible for the FIT. Because FIT rates will be based on actual cost plus profit, it is proposed that FITs for emerging technologies be phased in over time. Given the desire to ensure that the price established in the FIT for the various renewable technologies and size of technologies is reasonable, and that the installation of these renewable resources does not negatively impact the utility's electric system, the first phase would be devoted to renewable energy technologies with a proven track record in Hawaii and with known cost data. This will help to ensure that the rates established for the FIT tariff are reflective of the cost of generation plus a reasonable profit, and help to maintain system reliability given that the impacts of the operating characteristics of the technologies on the utility's system are somewhat known.

The following technologies and maximum contracted capacities are proposed to be included in the first phase of the FIT implementation:

- Photovoltaic (PV) systems up to and including 500 kW[11] on Oahu, 250 kW on Maui and Hawaii Island, and 100 kW on Lanai and Molokai.
- Concentrated solar power (CSP) systems up to and including 500 kW on Oahu, Maui and Hawaii Island, and up to and including 100 kW on Lanai and Molokai.
- In-line hydropower systems up to and including 100 kW on Oahu, Maui, Lanai, Molokai, and Hawaii Island.
- Wind power systems up to and including 100 kW on Oahu, Maui, Lanai, Molokai, and Hawaii Island.

Phase 2 implementation, via the FIT Update process, will give priority consideration to developing tariffs for the following technologies:

- Wave energy generating systems;
- Landfill gas generating systems;
- Sewage-based digester gas generating systems;
- Biomass, including biomass crops, agricultural and animal wastes, and municipal solid waste; and
- Liquid biofuel-fired systems.

The following section provides a summary of the rationale for selecting the technologies for the first phase of FIT implementation.

3.4.1.1 Rationale for Initial Targeted Resources

"Renewable energy", as defined in Hawaii's renewable portfolio standards statute at Hawaii Revised Statutes ("HRS") §269-91, means energy generated or produced using the following sources:

a. Wind;
b. The sun;
c. Falling water;
d. Biogas, including landfill and sewage-based digester gas;
e. Geothermal;

[11] For inverter based technologies, contracted capacity refers to kW ac.

f. Ocean water, currents, and waves;

g. Biomass, including biomass crops, agricultural and animal residues and wastes, and municipal solid waste;

h. Biofuels; and

i. Hydrogen produced from renewable sources.

HECO and the Consumer Advocate recognize the desire to encourage development of the full variety of resource types and technologies listed in HRS §269-91. However, as noted in the December 11, 2008 PUC Scoping Paper[12]:

> Within each of these listed technologies, there may be subsets such as onshore wind versus offshore wind, biomass from varying feedstocks, or project size. A residential rooftop solar PV installation, for example, has a different cost structure than a large-scale solar PV installation. Location may influence the underlying costs of a project (e.g., public land on Oahu versus private land on Kauai). What is the cost and availability of real estate? What is the proximity to transmission and load? Are the underlying cost factors different on different islands for the same technology such as geothermal? These questions and others must inform tariff design.
>
> With probably over a dozen different technologies, some of which require further segmentation by size or location, the number of PBFiTs needed is large. The Commission may wish to focus on PBFiTs that merit priority attention based upon the projects under consideration, or that might be more likely candidates for consideration based upon the existence of a reasonable PBFiT.[13]

HECO and the Consumer Advocate agree that initially, the FIT should target those technologies that are actively being developed in Hawaii because of the availability of specific cost data upon which to develop the FIT rate for each such technology. In addition, the impact of the operating characteristics of these types of technologies is generally known. Finally, the recommended project types and sizes are expected to be more straightforward to implement because the interconnection requirements are not as complex as those of larger systems and lend themselves to use of standardized energy rates and power purchase contracting. Focusing on these resources will allow the Commission and stakeholders to more readily develop the initial

[12] CPUC Scoping Paper - FITs: Best Design Focusing Hawaii's Investigation, National Regulatory Research Institute, December 2008.

[13] PBFIT is defined as a project based feed-in tariff.

FIT. HECO and the Consumer Advocate stress that the FIT should be regularly reviewed to encompass more technologies, and propose to do so within two years of the initial FIT, with ongoing reviews every three years thereafter.

Thus, the proposed FIT initially targets renewable resources that (1) do not require complex environmental and land use permitting which may impose significant uncertainties in project development timeframes and costs; (2) do not inherently, by virtue of their operating characteristics and size relative to the utility system, require extensive and lengthy interconnection studies which may identify the need for significant interconnection requirements; (3) utilize technologies for which complex financial accounting issues relative to utility power purchase contracts have already been addressed, and (4) have already been, or are currently in the process of being, implemented in Hawaii in commercial, non-R&D, application.

The first criterion refers to environmental permits and review processes including HRS §343 environmental assessments and impact statements, covered source air permitting, and changes in zoning. Each of these processes requires significant time and resources, and approval is at the discretion of the permitting or review agency. Furthermore, potentially costly project modifications may be required by the reviewing agency, which could significantly impact project economics and timing.

Similarly, the second criterion refers to the fact that larger generator sizes and certain technologies will inherently increase the potential for utility grid impacts, and may require more extensive technical review and requirements to safely and reliably interconnect to the utility grid. For example, larger, "central station" generating resources must go through a complex interconnection requirements study ("IRS"). Even "distributed generation" resources interconnecting into distribution circuits may trigger the need for more extensive studies and interconnection requirements. As discussed elsewhere, the proposed FIT adopts the HECO Companies' Interconnection Tariff Rule 14.H to ensure that safety and reliability are not compromised. One of the critical technical issues is the aggregate penetration of generation resources on a distribution circuit. In Rule 14.H, a more extensive interconnection study may be triggered if the aggregate penetration of generation resources on a circuit exceeds 10 percent of the circuit peak load.

With regard to the third criterion, complex utility accounting issues must be addressed for each type of long-term arrangement the utility enters into. Considerations in the accounting assessments include: the type of fuel source (i.e. sun, wind, waves, biomass), the maturity of the technology, the reliability of the technology, the structure of the payments (i.e. per kWh delivered, per kW available, penalties, bonuses), and the nature of the contract (i.e. firm, as-available, scheduled, etc.). These accounting issues have been addressed for existing and proposed power purchase agreements and certain accounting conclusions are reasonably applied broadly to some technologies. For example, as-available PV and as-available wind power purchase agreements to date have not resulted in capital lease obligations being recorded on the utility's financial statements. Other technologies which have other characteristics might result in different accounting conclusions. Arrangements which reflect a contract for use of the asset may result in different accounting treatment (e.g., a capital lease obligation being recorded), which may have different financial consequences to the utility. For instance, an arrangement that results in a capital lease may impact the financial structure (i.e. debt/total capitalization ratio) of the utility, which could have an impact on the utility's cost of capital. These accounting issues will ultimately be resolved in the course of other Commission proceedings or processes, but the timing of such may not support the desired timeframe to adopt an initial FIT.

Finally, it is the intent of the HECO Companies and the Consumer Advocate to initially prioritize those technologies for which there is already a high degree of demonstrated market desire and development experience in Hawaii, to be followed shortly thereafter in the first FIT Update by technologies that have been used elsewhere but have high potential in Hawaii. The proposed approach will provide additional time to gather data on the other technologies in order to establish reasonable pricing for technologies that are unproven or for which there has been no commercial experience in Hawaii.

Applying the criteria above, the HECO Companies and the Consumer Advocate propose that the initial FIT be focused on PV, CSP, in-line hydropower, and wind, with individual project sizes targeted to provide a greater likelihood of more straightforward interconnection, project implementation and use of standardized energy rates and power purchase contracting. A size of 100 kW was considered the starting point for all proposed technologies and islands given the existing provisions of Schedule Q and net energy metering that accommodate projects of this size. The 100 kW size was deemed appropriate for all FIT technologies for the islands of Lanai and Molokai given the very small sizes of the grids.

Consideration was then given to whether there was any basis to increase the proposed size eligibility for any technologies based on other factors, such as the potential for streamlining interconnection reviews. The HECO Companies' Rule 14.H interconnection tariff allows for expedited review of inverter-based systems up to 250 kW, provided that the cumulative amount of generation installed on the distribution circuit does not exceed 10% of the circuit load. Based on this allowance, the FIT size threshold for PV was increased to 250 kW for Maui and the Big Island. For PV on Oahu, a larger 500 kW project size is proposed out of recognition that compared to the Big Island and Maui, there is a lower amount of PV penetration relative to the size of the grid, and there would be less likelihood for cumulative island-wide PV penetration issues. Also, HECO and the Consumer Advocate noted that the focus of the Net Energy Metering Pilot Program ordered by the Commission in Docket No. 2006-0084 is on PV systems up to 500 kW. Finally, a CSP project size of 500 kW is initially proposed based on a CSP project currently under commissioning on the Big Island, recognizing, however, that the particular project did require a detailed interconnection requirements study and "grid-friendly" control and communication provisions.

The PUC's December 11, 2008 letter directs the parties to the FIT docket to submit cost information for a variety of technologies, therefore it is possible that sufficient information will be provided via this directive that additional technologies may be included in the initial FIT.

3.4.2 New and Existing Generation

All new renewable energy generation within the proposed generator size and type targets that comes online after the adoption of FITs would be eligible for FIT contracts. An existing generator that is repowered would be considered a "new" renewable energy generator and therefore would be eligible to be compensated at the FIT rate. Similarly, capacity additions to existing renewable energy generation would also require the entire capacity to be placed under a FIT, if the energy is to be sold under the FIT.

3.4.3 Overlap with Net Metering and Schedule Q

Consistent with the HCEI Agreement, the HECO Companies and the Consumer Advocate recommend that no applications for new net energy metering contracts will be accepted once the FIT is formally made available to customers[14] All net energy metering systems under contract, or contracts in the process of utility review at the time the FIT is formally made available to customers, will be grandfathered. Such grandfathering would apply for the life of the net energy metered system, meaning changes in ownership of net energy metered systems will be allowed. Expansion of net energy metering system capacity will not be allowed once the FIT is established.

[14] Net energy metering is required by statute, and potential statutory changes may be necessary to implement this recommendation

Similarly, the HECO Companies and the Consumer Advocate recommend that no applications for new Schedule Q contracts will be accepted once a FIT is formally made available for the resource type. Schedule Q will continue as an option for qualifying projects of 100 kW and less for which a FIT is not available.[15] All Schedule Q systems under contract, or contracts in the process of utility review at the time the FIT is formally made available to customers will be grandfathered through the term of their Schedule Q Agreement. The HECO Companies will not initiate termination of such contracts for the purpose of moving a Schedule Q generator to the FIT.

Existing net metering customers and Schedule Q generators would have the option of opting in to FITs at any time, provided that they meet the FIT standards, within the proper FIT category, and the remaining useful life of the system is at least as much as an available FIT term; or staying under their existing contractual arrangements through the term of their agreement. If either a net metering or a Schedule Q generator opts into a FIT, they must stay under the FIT—they cannot return to being either a Schedule Q or net metering generator. Also, should either a net metering or Schedule Q customer add a new eligible renewable energy system, then that system will be treated separately from the net metered or Schedule Q system and will only be eligible for the FIT or a negotiated power purchase agreement. Expansion of net metering or Schedule Q system capacity will not be allowed once an applicable FIT becomes available. Net metering and Schedule Q generators could also continue under their existing arrangements if there is a change in system ownership, although the utility may require the owner to execute a new net metering or Schedule Q agreement.

3.4.4 Utilities Participating

FIT rates will be set at each HECO company, for each island. Eligibility will be on an island-by-island basis, meaning that eligible renewable energy generators on one island cannot apply for a FIT that is in effect on another island.

[15] The HECO Companies and the Consumer Advocate recognize the Commission's order suspending the Schedule Q Docket, in light of the development of the FIT. Although the Schedule Q Docket has been suspended, Schedule Q remains an available tariff to eligible generators. Schedule Q generators currently under contract consist only of in-line hydro and small scale wind resources, which are included in the initial set of proposed FIT technologies.

3.5 Setting the FIT Rate

This section describes the proposed FIT rate structure and potential methodology for establishing FIT rates. The HECO Companies and Consumer Advocate will respond either jointly or separately to the Commission's December 11, 2008 request for cost information, as well as address the questions in Appendix C of the National Regulatory Research Institute's paper provided by the Commission ("PUC Scoping Paper") concerning project cost-based FIT pricing and avoided cost. The HECO Companies and the Consumer Advocate, as stated in the HCEI Agreement, support FIT rates that are designed to cover the producer's costs of energy production plus reasonable profit.

The HECO Companies and the Consumer Advocate agree that tariff pricing should differentiate between technology type, project size, and location, and should be based on the costs of developing a "typical" project that is reasonably cost-effective. In this manner, the FIT payment rates will not encourage development of generation that is not cost-effective, consistent with the Commission's policy on distributed generation stated in Decision and Order No. 22248 in Docket No. 03-0371.

Generally, project cost-based energy payment rates are established based on a target internal rate of return ("IRR"), knowledge of project and generation cost information, and energy production. Ultimately, the Commission must determine the acceptable target IRR. The HECO Companies and the Consumer Advocate propose that FIT pricing be reviewed regularly in the course of the FIT update process, and that an independent consultant be used to compile information and make recommendations on assumptions for the costs of generation and energy production levels.

3.5.1 Structure

The base tariff rate by technology will be paid to generation projects that have grid-friendly features such as being utility dispatchable or curtailable, or have low-voltage/low-frequency ride-through capabilities. The base FIT will be adjusted downwards for renewable energy systems that do not have these features, if allowable from a system integration perspective.[16] In addition,

[16] The degree to which grid friendly features will be required in the FIT will depend on the specific island. For example, at HELCO, the high amount of variable generation already on the system will likely require that all inverter-based systems 30 kW and larger implement expanded under-frequency ride through, authorized under Rule 14.H and in conformance with IEEE 1547. Thus, the HELCO FIT would assume this capability in its consideration of quantity targets.

FITs will be differentiated by system size as warranted by technical requirements or where there are recognizable differences in typical project costs.

A hypothetical illustration for different sized PV systems is provided in the table below. As displayed, different technical attributes are to be either encouraged or required depending on the size of the PV system and the utility grid in question. The table shows that in the case of PV systems greater than or equal to 30 kW, this FIT requires expanded ride-through capability. Furthermore, a lower rate is paid to systems that are not curtailable, since they do not provide as much flexibility from a grid operability standpoint and may actually impose more costs on utility ratepayers, (e.g., by causing curtailment of other, less expensive energy sources). The hypothetical table also illustrates that for the more grid-friendly systems, greater annual quantities are targeted. Finally, energy payment rates may be higher for smaller systems due to higher project costs caused by lower economies of scale, smaller tax incentives, and other factors. In the hypothetical example, a 24¢/kWh rate is paid to smaller PV systems with expanded ride-through capability, while the largest systems with the same technical attributes are paid 18¢/kWh.

A FIT rate structure would be developed for each technology type and for each island, recognizing that technical attribute requirements and project costs differ from island to island.

Table 3-1
FIT Program Design Matrix – Hypothetical Values

Island "X"					
	Technical Attributes		Annual Quantity Target		
	Curtailable	Expanded Voltage/Frequency Ride Through	2010	2011	FIT Rate, ¢/kWh
100 kW <PV≤ 250 kW	Yes	Required	8 MW	8 MW	22
	…	Required	2 MW	2 MW	18
30 kW ≤ PV ≤ 100 kW	Yes	Required	5 MW	5 MW	23
	…	Required	2 MW	2 MW	19
PV < 30 kW	…	Yes	3 MW	3 MW	24
	…	…	1 MW	1 MW	20

FIT rates will be subject to Statute HRS § 269-27C2 that caps the ability of the Commission to set the costs for non-fossil fuel resources at 100 percent of the utility's avoided cost. Since a policy goal is to delink payments to generators from the utility's avoided cost levels, ratepayers will obviously benefit if the FIT rates for generators are below the utility's avoided cost. However, should Hawaii wish to pursue more emerging renewable energy technologies via a FIT, as has been done in other countries, HRS § 269-27C2 may serve as a limitation, as the potential FIT rate for these emerging technologies will likely be higher than the utility's avoided cost. The HECO Companies' position is that for the FIT to be successful and to also meet the HCEI goal of delinking energy payments from avoided cost, the FIT rates should be set at the cost of generation for each technology (plus profit), regardless of whether it is above or below avoided cost. Overall ratepayer impacts can be managed via setting of the targeted project size and annual FIT quantity targets. This position may require a change to HRS § 269-27C2.

FIT rates will be further differentiated by the availability of federal and state incentives that may or may not be in place for different renewable energy technologies. Because of the on-again, off-again availability of the federal production tax credit (PTC), it is proposed that FIT rates will automatically be adjusted up or down by the amount of the PTC, depending on whether the PTC is in place or not.

The FITs will be revisited during the initial review that is proposed to be held two years after the initial adoption of the FIT, and every three years thereafter. Once the locational value maps are available from the Clean Energy Scenario Planning process, it may be desired to further differentiate FIT rates depending on whether a renewable energy generator is located in areas identified by the locational value maps.

3.5.2 Methodology for Setting the FIT Rate

Setting the feed-in tariff rates for each of the eligible technologies requires assessing a price at which the target generator[17] will be viable, covering all of its actual costs and providing a sufficient rate of return to investors to attract investment. The proposed structure envisions, at its simplest level, a base rate that would be levelized on a nominal basis, e.g. $150 per MWh, for the duration of the feed-in tariff contract. This nominal levelized rate will not be altered for the duration of the contract, providing revenue certainty to the generator which in turn influences the cost of capital as well as financing fees and other soft costs relating to financing and contracting.

Consistent with the PUC Scoping Paper, we recommend using a model that uses a Discounted Cash Flow (DCF) analysis methodology to assess such nominal levelized feed-in tariff rates based on the cost of generation plus a target return on investment (ROI), or Internal Rate of Return (IRR), for the project over the life of the system. The base rate represents, for a project coming on line in a given year, a nominal levelized payment stream that has the same net present value (NPV) as the projected stream of costs and capital flows that provides the target IRR to project owners. This approach is similar to the more simplified Levelized Cost of Energy (LCOE) methodology commonly used for analysis of electricity generation costs. The LCOE is a measure of total costs of a system (over its expected lifetime) divided by the expected energy output (over its useful lifetime), with appropriate adjustments for the time value of money. The LCOE provides a useful mechanism to compare the cost of energy across different

[17] In considering the cost of a target generator for each technology, it is important to understand that there are a range of applicable costs for any particular technology. Idealized cost components vary depending on site-specifics, scale, resource quality, interconnection costs (a function of voltage, distance from the transmission or distribution facilities to which the project will interconnect, and other site-specific factors). In principle, a feed-in tariff rate can be set at a level that is aggressive (meant to capture most of the projects within this range) or conservative (meant to support only the most cost-effective installations). We recommend setting the price based on middle-of-the-range cost estimates (neither aggressive nor conservative), intended to support an average cost or better installation within the range of possibility.

technologies. On a simplified basis, LCOE is the net present value of total life cycle costs divided by the quantity of the energy produced over the life of the project.[18]

The DCF approach accounts for a comprehensive set of financial cash flow and tax inputs as well as performance characteristics in a financial model over a specified period of time. The analysis considers cash flows over the project's assumed economic life. If the contract duration is shorter than the assumed economic life, assumptions must also be made about the residual revenue stream for the remainder of the project economic life. The inputs that go into the DCF analysis include:

- Capital costs: This component includes installed capital costs for both generation equipment and transmission and interconnection, including applicable sales taxes. It may also consider, as applicable, net decommissioning costs (if decommissioning costs are expected to exceed any residual value) or residual value.

- Project performance: including net capacity factors, estimated project life and projected generation degradation. In addition, an adjustment may be appropriate to account for reduced energy sales under tariffs that allow for curtailment.

- Initial development costs: including engineering, permitting, environmental, management, legal, accounting, and contracting costs.

- Financing costs and cost of capital: including construction financing, up-front financing fees and transaction costs. The cost of permanent financing involves making assumptions about the assumed capital structure as well as the cost of debt (if used) and the target IRR.[19] Lender requirements such as reserves and minimum debt coverage ratios should also be considered as applicable.[20]

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[18] The Drivers of the Levelized Cost of Electricity for Utility Scale Photovoltaics, Sunpower Corporation, August 2008

[19] Note that appropriate capital structures may vary based on the type of generation, its scale, and the degree to which I relies on monetization of tax incentives such as Federal Production Tax Credits (PTC) or Investment Tax Credits (ITC).

[20] Such requirements depending on whether debt is assumed to be used, and may vary based on the type and scale of generation as well as reliance on tax incentives.

- Ongoing costs: these include estimates of the following costs both initially and as they change (escalate) over time: fixed and variable O&M expenses; fuel costs (if any); replacement parts; land lease costs; insurance; state and Federal income taxes (including the tax effects of depreciation), property taxes, excise and all other applicable taxes. Any ancillary service or volumetric costs or charges typically required of and imposed on generators should also be accounted for. These types of services will vary widely depending on the project and location.

- Applicable Federal and state tax or other incentives.

- Discount rate: a discount rate must be selected for determining the equivalent NPV of the projected and levelized revenue streams. While the discount rate selected is typically related to the cost of capital, we recommend selecting a common discount rate to apply across all technologies for this purpose, as the required equity returns (IRR) may vary be technology.

Using this methodology, the nominal levelized tariff energy rate can be set to cover expected costs and provide a target IRR which the Commission deems to be reasonable.

There are many spreadsheet models available that utilize this approach. For instance, KEMA has recently developed a model for Public Service New Mexico that is a simple spreadsheet analysis tool that assesses the LCOE, ROI and IRR for a number of different utility owned distributed generation business models. In addition, NREL has a spreadsheet-based model called the Financial Analysis Tool for Electric Energy Projects (FATE-2P) that can model a number of commercial project ownership options.[21]

There are also many guidebooks available that provide detailed information on LCOE methodology. The National Institute of Standards and Technology (NIST) recently published an update to the NIST Handbook 135, Life-Cycle Costing Manual for the United States Department of Energy Federal Energy Management Program (FEMP). This guidebook is designed to provide energy price indices and discount factors for performing life-cycle cost analyses of energy and water conservation and renewable energy projects in federal facilities. The publication supports private-sector life-cycle analysis by updating the energy price indices and discount factors and illustrates the relevant equations for performing LCOE analysis. We

[21] http://www.nrel.gov/wind/coe.html

recommend that each of these serve as reference guides for development of the DCF model to support FIT development in Hawaii. [22]

3.5.3 Recommended Process to Determine FIT Rates

The HECO Companies prefer relying on well-documented, capital cost and operating data for the various types of resources to be covered under a FIT, adjusted for Hawaii-specific conditions as appropriate. In this regard, the HECO Companies agree with the PUC Scoping Paper statement that "a regulator should examine typical costs and operating characteristics for that type of project, rather than the costs and characteristics of a single particular project using that technology" and "all cost and operating estimations should, however, be Hawaii-specific to the extent that Hawaii's unique geography affects cost." This led the HECO Companies to put forward a FIT proposal that initially covers the known technologies under development in Hawaii.

Given the wide scope of the inputs needed to determine FIT rates, the initial FIT targets those resources for which reliable cost and production data can be obtained, especially considering Hawaii-specific factors. The following list provides a possible tariff setting process, recognizing that initially, a streamlined process will likely be used considering the parties' responses to the Commission's December 11, 2008 information request.

- The utility hires an independent consultant (or alternatively, the utility pays for an independent consultant who can report to the Commission, the cost of which is recovered in rates).
- The consultant is tasked with compiling cost of generation data for each FIT project category. The cost of generation data should specifically account for Hawaii cost factors including cost of land, permitting, labor, materials, etc. The data should also take into account typical interconnection costs that may be required for each of the islands. The consultant should develop the cost of generation for what would be considered a "typical" project, meaning at the midpoint of the range of projects, keeping in mind the Commission's policy to encourage development of cost-effective distributed generation.
- With the cost of generation defined, the consultant should set forth the assumption for the amount of energy produced by the "typical" project on an island-by-island basis,

[22] Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis, U.S. Department of Commerce Technology Administration, National Institute of Standards and Technology, May 2008.

assuming Hawaii specific data such as average solar insolation, wind resources, and so on. As much as possible, this data should be sourced from published sources such as NREL so that there is transparency in the assumptions used. The energy production assumptions should also be consistent with commonly accepted industry practice, for example, the annual percent degradation in energy output from PV panels. Where there is a documented difference in energy production from one region on an island to another, such as may be the case with solar insolation on the windward side of an island versus the leeward side, the consultant should recommend a basis for the island-wide energy production assumption, keeping in mind the FIT design objective of providing reasonable incentives to cost-effective renewable energy providers while minimizing costs to ratepayers.

- The consultant will assume that project developers are able to use all published federal and state tax incentives, taking into account potential expiration dates. For example, if a tax credit is set to expire after the first year of the period for which the FIT rate is being established, then the FIT rate calculation for the second year and beyond would assume no tax credit in that year and there would be a bump in the FIT rate. Since it is often difficult to predict what Congress or the State legislature may do with tax incentives from year to year, and since a FIT update is proposed on a multi- year cycle, the tariff should allow an unscheduled adjustment to the FIT rate if there are unexpected changes in tax incentives or other material changes in the assumptions.
- The Commission, in its D&O in this docket, should rule on what is an acceptable IRR. The consultant would use that IRR to come up with proposed new FIT rates.
- The utility would file these rates as part of the regular FIT update process.

3.6 Annual FIT Quantity Targets

The HECO Companies note that the PUC Staff Scoping Paper states that caps could be placed on installed capacity, expected production or rate impacts. The HECO Companies chose installed capacity, as it is difficult to estimate precisely the estimated production that may come from FIT generators, and a quantity cap can be designed that takes rate impacts into account. Annual FIT quantity targets will be established for each technology for each island and will be regularly updated in the course of the FIT Update. The annual quantity targets will be based on both technical and non-technical considerations, including the following:

- ***Renewable portfolio standards requirements ("RPS").*** The Hawaii RPS requires the HECO Companies to obtain 20 percent of net electricity sales from renewable electrical energy by 2020. The HCEI Agreement proposes to increase the RPS renewable generation requirement to 40 percent by 2030. The FIT will serve to incent the installation of renewable generation at an increased rate.

- ***The goals of the Hawaii Clean Energy Initiative ("HCEI").*** The overarching objective of the HCEI is the "economic and culturally sensitive use of natural resources to achieve energy supply security and price stability for the people of Hawaii, as well as significant environmental and economic opportunities and benefits." A FIT will act to allow for the economic development of the State's abundant renewable resources, which will provide both environmental and economic benefits by reducing reliance on expensive, imported fossil fuels.
- ***Technical attributes of the resources***. Higher annual FIT quantity targets can be set for FIT systems that support reliable grid management such as low-frequency ride through, the ability to provide reactive power and the ability to be curtailed or dispatched by utility system operators.
- ***Characteristics of the utility systems being interconnected.*** Certain HECO Companies are able to incorporate more FIT generation than others, due to variations in the size and robustness of the transmission and distribution grid and the differences in customer load among the islands. The annual quantity targets will be designed to account for these differences.
- ***Cumulative amounts of installed variable resources***. Setting of the annual FIT quantity targets for each island must consider the cumulative amount of variable generation that is installed island-wide, including via resource acquisition mechanisms besides the FIT. Certain HECO Companies already have a significant level of RPS-eligible and distributed generation capacity and may have correspondingly less ability to incorporate higher levels of FIT-eligible resources. HELCO, for instance, already receives over 30 percent of its energy from RPS-eligible resources, with an increasing level from distributed generation resources. The large penetration of variable, non-dispatchable generation has resulted in fewer generating units on-line providing grid stabilization and frequency regulation, reduced island system stability, and greater frequency swings due to the variable generating output from wind and PV technologies. Curtailment of renewable generation at HELCO is already occurring at times to maintain system stability.

  There is a need to establish high level cumulative system targets for intermittent generation by island to avoid system stability issues and reduced system reliability. The cumulative system capacity targets should include all variable generation including independent power producers, net energy metered systems, and FIT systems that will contribute to island system stability issues. The high level cumulative target settings by island will be incorporated and regularly updated in the CESP process. The annual FIT quantity targets will take this into account when the data become available. In the interim, to manage this issue for those island systems that are already highly sensitive to adding more variable resources such as at HELCO, the initial proposed FIT will target resources with grid-friendly features.

- ***Impacts on curtailment of as-available energy from existing resources.*** Some of the HECO Companies already curtail generation, including renewable energy generation, in order to maintain system reliability, such as during times of high wind generation at minimum system load periods. Adding additional variable generation via the FIT that is not controllable may increase the amount and frequency of existing renewable generation that is curtailed. The annual FIT quantity targets and requirements for curtailment of certain types of FIT resources must take this into account.
- ***Projected energy production levels***. The HECO Companies and the Consumer Advocate have agreed to initially limit the FIT to a subset of RPS-eligible technologies in part because these technologies are already, or are in the process of being, implemented in Hawaii in commercial applications. Therefore, projected energy production levels from these FIT-eligible resources can be made with greater confidence that the energy will in fact be produced to meet ratepayer needs. There is greater uncertainty as to whether the energy from technologies that have not been deployed commercially in Hawaii, or are at a more R&D stage than other technologies will in fact materialize. Because of the proposed quantity and size targets and queing process for interconnection, it is necessary to ensure that the projects are likely to materialize. Waiting until the first FIT Update to add the Phase 2 technologies listed above will allow time for more information on cost and projected energy production levels to be gathered and increase the likelihood of successfully implementing the FIT as well as the generation technologies coming on-line.
- ***Ratepayer impacts.*** Under a FIT, the HECO Companies will purchase generation from eligible FIT resources. Annual FIT quantity targets should consider the total amount of FIT power purchase costs from year to year and the resultant impacts on ratepayers. Consideration of ratepayer impacts should also take into account ratepayer impacts from other resource acquisition mechanisms.
- ***Impacts on utility credit ratings.*** Power purchases may affect the HECO Companies' credit rating, as the credit rating agencies view these purchases as potential debt for the HECO Companies. Should the HECO Companies' credit ratings be lowered for any reason, financing costs for the HECO Companies may increase. Therefore, the ability of

the HECO Companies to purchase generation from third parties without affecting the HECO Companies' credit rating will affect the determination of annual capacity targets for the FIT. Imposing an annual FIT quantity target, plus the HCEI agreement to include 10% of the utility's purchases under the feed-in tariff in rate base through January 2015, will help mitigate this issue.

- ***Administrative resource requirements***. Deploying the FIT will require the HECO Companies to process FIT applications, conduct Rule 14.H interconnection reviews, and otherwise administer the tariff. The annual FIT quantity target will aid in managing these administrative resource requirements.
- ***Other policy goals including the desire to provide fair opportunity to multiple developers or to encourage development of certain market segments.*** How the FIT is designed will impact the development of certain market segments, such as residential and small commercial PV systems. Specific elements of the FIT should facilitate the development of these markets. These elements include quantity targets, interconnection requirements, and eligibility.

To aid in determining the interim annual quantity targets, the HECO Companies have asked KEMA to assist with the following:

- Recommend a methodology for determining interim annual quantity targets for each island; and
- Define a longer term process to periodically review the system impacts and allow for revisions to the annual quantity targets for each island.

As the impacts of the interim annual quantity targets are assessed, the interim annual quantity targets will be reviewed to determine whether these targets need to be adjusted, with the first review to occur two years from when the FIT is first adopted. Thereafter, the annual FIT quantity targets will be reviewed and adjusted if necessary every three years in the FIT Update process.

3.7 Interconnection

The proposed FIT will require compliance with the HECO Companies' interconnection review processes and tariff, known as Tariff Rule 14.H. Rule 14.H will be reviewed and modifications proposed in the course of the HECO Companies' commitments under the HCEI Agreement to accommodate the export of power to the utility grid under the FIT. Provisions for expedited interconnection review that are currently in Rule 14.H will be applied to the FIT program. For example, Tariff Rule 14.H provides for expedited interconnection review of inverter-based (e.g., PV) systems up to 250 kW assuming there are no issues with distribution circuit penetration levels. Provisions under Rule 18 Net Energy Metering which allow streamlined review for PV systems of 10 kW and smaller will be reviewed and retained to the extent possible, considering that all power generated is exported to the utility grid under a FIT.

In general, FIT generators will continue to be responsible for the costs of interconnection to the HECO Companies' grids, in conformance with the HECO Companies' Rule 14.H interconnection requirements and processes and the Commission's Decision and Order No. 22248 in the Distributed Generation Investigative Docket No. 03-0371. However, in keeping with the intent of the FIT, reasonable FIT generator interconnection costs, including costs of interconnection studies and modifications to the utility system, will be assumed in the establishment of FIT payment rates for different generator categories. For example, for generators less than 10kW, minimal interconnection costs will be assumed, whereas for larger FIT generators in the 250kW to 500kW range, a reasonable allowance for costs of interconnection will be incorporated in the FIT payment rate for that generator size range.

Consistent with the provisions of the HCEI Agreement, the HECO Companies may choose to implement modifications on the utility system side of the point of interconnection to facilitate distributed energy resource utilization beyond an individual FIT installation, the costs of which will be recovered through the Clean Energy Infrastructure Surcharge and later placed in rate base in the course of the next rate case proceeding.[23]

In parallel with adopting and implementing a FIT, the HECO Companies will perform a review of Rule 14.H by the end of June 2009 to address necessary modifications to accommodate distributed generation which is encouraged by FIT. Modifications to Rule 14H will be necessary to enhance system reliability, safety and visibility of distributed generation systems on the grid in light of the export of power from FIT systems to the grid, and grid-specific technical issues and constraints. KEMA has been retained to help with this assessment. In addition, the HECO Companies will more fully utilize existing elements of Rule 14.H and IEEE 1547 to integrate higher amounts of distributed renewables. For example, to accommodate additional PV, HELCO is reviewing expanded under-frequency ride through requirements for distributed generators greater than or equal to 30 kW in size as currently allowed by Rule 14.H and IEEE 1547.

As provided in Appendix A, the design of the FIT and interconnection requirements must take into account the unique nature of the isolated island grids in Hawaii and the technical challenges

[23] HCEI Agreement, page 27.

with integrating large amounts of distributed FIT renewable resources on island power systems. The following key considerations with renewable generation and their impact on system reliability are discussed:

1. Intermittency of Power Output
2. Frequency Regulation
3. Ride Through Capability
4. Dispatchability
5. Curtailability
6. Peak Load Contribution
7. Non-Peak Load Contribution
8. Local Impacts on Feeders.

Overall system impacts of greater levels of intermittent generation will be considered in the Clean Energy Scenario Planning process, and these impacts will be managed in part by the regular review of the annual installed quantity targets of the FIT.

3.8 Queuing

Applications for FITs will be taken on a first-come, first-served basis. A public notice will be issued and filed with the Commission should enough applications for a FIT be filed to meet or exceed the island-specific annual quantity target. Applications for a FIT will continue to be accepted and placed on a waiting list, also in order of when the application is filed. Generators on the waiting list will move up the list should generators who have entered into a contract under a FIT withdraw or fail to meet deadlines for coming into operation, as is discussed later in this proposal. More applications for the FIT may also be accepted in the future during the policy review of the FIT and from reviews of the annual quantity targets.

3.9 Contract Duration

The proposed term length for FIT contracts will consider (1) industry-standard assumptions on service life, and (2) recent contracting experience. Based on recent contracting experience in Hawaii including HECO's power purchase agreement for the Archer Substation PV project, a 20 year term is proposed for newly installed PV systems. A 10 year term is proposed for newly installed CSP systems based on HELCO's recent power purchase agreement with Keahole Solar Power LLC. Additional information is being gathered for in-line hydropower and small scale wind.

Following the initial term, projects will be allowed to extend their contracts on a year-by-year basis subject to a FIT energy rate appropriate for the specific project circumstances.

3.10 Cost Allocation

Power purchase costs under the FIT would be reflected in the operating costs of the utility acquiring the energy under the power purchase arrangement. Cost allocation among the HECO Companies may be revisited if a cross-island transmission cable is constructed.

3.11 Credit Performance and Assurance

To ensure that speculative projects do not tie up available capacity under the annual capacity targets for the FIT, a refundable application fee would be assessed when a generator applies for a FIT. The refundable fee would be set on a $/kW basis and would be differentiated by project size. The application fee would be refunded once the generating project begins operating. However, the application fee, and the generator's place in the FIT queue, would be lost should project development not be completed within the timelines as outlined below:

Table 3-2
Suggested Project Development Timelines

Technology	System Size	Months
Small PV	<10 kW	12
Small Wind	<10 kW	12
Small CSP	<10 kW	12
Small in-line hydro	<10 kW	12
PV	> 10 kW	24
Wind	> 10 kW	24
CSP	> 10 kW	24
In-line Hydro	> 10 kW	24
Landfill Methane	> 10 kW	24
Small MSW	> 10 kW	24
Methane from Municipal Wastewater	> 10 kW	24

A time extension matching the original project development timeframe (i.e., 12 months for certain projects, 24 months for other projects) can be gained with an additional fee, also to be differentiated by project size. The fee would be refunded should the project come on-line but be lost if the project is not developed. Should a project not meet these deadlines or withdraw for any reason, the next project in the FIT queue will be eligible for a FIT agreement.

3.12 Implementation Issues for Further Consideration

Several implementation issues should be explored as FITs are designed and implemented, including whether to require warranties for renewable energy systems, particularly smaller renewable energy systems; whether minimum performance requirements should be imposed; and metering and inspection requirements. Additionally, the ability to curtail FIT resources for purposes of maintaining system reliability and stability needs to be considered. Finally, additional provisions may need to be included to reduce the chances of gaming of the FIT system, such as preventing a project developer from segmenting a single large project into multiple small projects to meet the FIT eligibility size limits.

It is recommended that eligible renewable energy generators show demonstration of having at least a 10-year warranty on critical equipment components for their system that will protect against defective workmanship, breakdown of individual equipment components or degradation in electrical output of more than 15 percent from the originally rated output over the 10-year period.

Meters should also meet certain accuracy standards. For smaller systems < 10kW, a meter accuracy of ±5 should be required. For larger systems (>10kW), meter accuracy of ±2 percent accuracy is recommended. Inspections will be every four years, as set out in the net metering rule.

The HECO Companies curtail generation at times to maintain system reliability and to manage difficult system conditions such as minimum load and high wind generation. It is the HECO Companies' position that under a FIT, the HECO Companies should have the ability to impose operational standards and requirements, including generation curtailment, in order to maintain system reliability and meet obligations to existing power purchase contracts. The initial proposed FIT will apply to smaller resources, the curtailment of which will not be technically feasible. As more experience is gained with FITs and the results become available from technical studies, curtailment can be revisited in the initial FIT update, as well as subsequent reviews.

4. Appendix A: Technical Integration Considerations

4.1 Overview of key technical challenges

This section describes the unique technical challenges of incorporating large amounts of distributed renewables on island power systems from an operations perspective, and establishes the need for Feed-In Tariff system caps and annual limits. This begins with a review of operations on an island power system, and the impact of various types of disturbances on system frequency. Next the potential impact of renewables on overall system stability and reliability is described, and why caps should be considered in setting tariffs. This is followed by a more detailed discussion on the impact of IEEE 1547 compliant distributed resources.

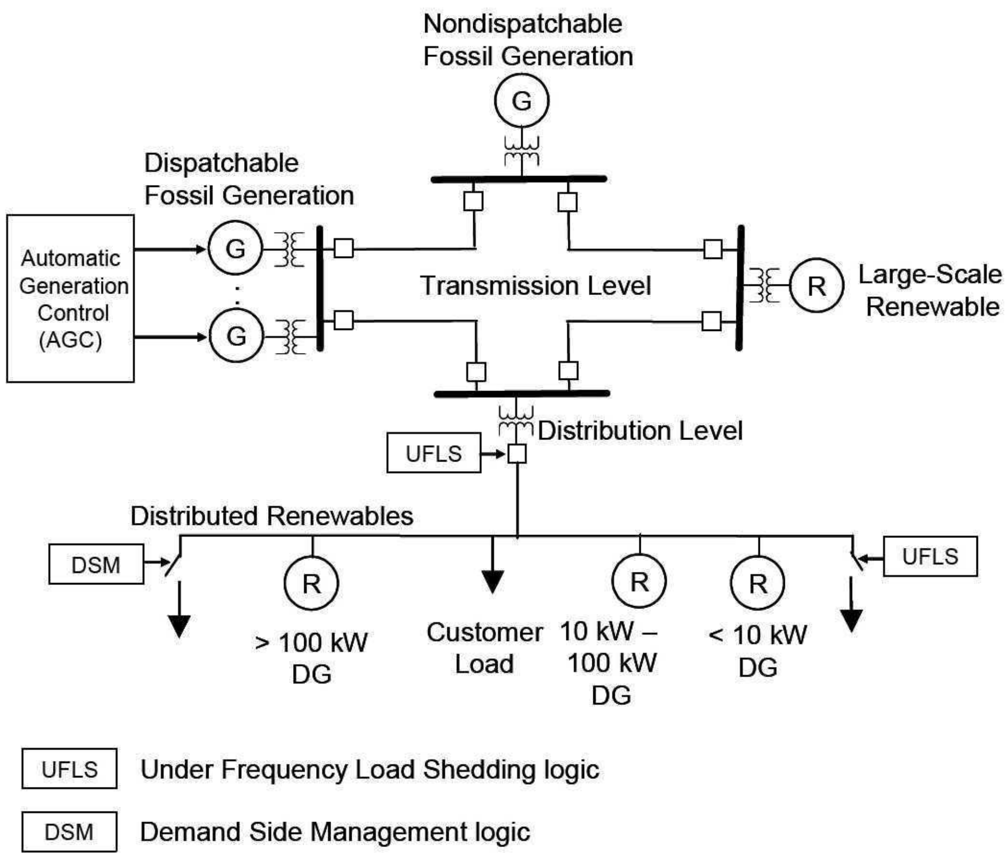
4.1.1 Island Power System Operation

A high-level view showing the interconnection of the various components of an island power system is shown in Figure 4-1. The transmission system provides the grid, which interconnects various large-scale generation sources to the end customer load. The generation consists of a mix of fossil-fired and renewable generation. A critical number of the fossil-fired generation units are operated under remote dispatch. What this means is that a centralized Automatic Generation Control (AGC) program can individually control the power output of these machines in order to balance the system demand with generation production (load-following) and regulate system frequency. For an AC power system, generation needs to be continuously adjusted to make sure that net generation output matches up to the total electrical load. This function is performed on every electric power system. However, for the smaller islanded or autonomous grid, the impact of load imbalance on frequency is much greater than is seen on a larger interconnection. The system has fewer resources upon which to draw to perform the balancing. AGC control continuously adjusts the generator power outputs of those units under its control to achieve frequency near 60 Hz, which represents a balance between load demand and power production. There are also nondispatchable units on the systems that are not controlled by the AGC. Nondispatchable fossil-fired units may play a role in regulating frequency, or in some cases cause imbalances in frequency. However, non-dispatchable generators are not capable of load-following under centralized AGC control.

Renewable sources of generation can be connected at either the transmission or distribution level. Large sources such as wind farms or geothermal are typically interfaced directly at the transmission level. The intermediate and smaller-size sources, such as rooftop photovoltaic systems, are distributed on the same medium-voltage feeders that serve the customer load. Having a certain amount of generation on the distribution feeders (an amount which never exceeds the demand on that distribution feeder and must be much less in cases where voltage and frequency deviations are used for anti-islanding protection) supplies local load, and effectively reduces the demand of the feeder which reduces the amount of power supplied to the feeder by the transmission system. There are however technical and operational challenges created by installing generation on the distribution system. The distribution system has not been designed for significant amounts of generation.

Another important mechanism for balancing power on electric power systems involves reducing or shedding load. This has primarily been used in the form of automated Under Frequency Load Shedding (UFLS) which automatically disconnects feeders for very low frequencies in order to halt the decline of frequency and prevent system failure. More recently, loss of particular types of load or specific loads are reduced under balancing emergencies through Demand Side Management (DSM). When there is an event that causes a large drop in generation, such as a generator unit trip, then a temporary imbalance is created between power generation and load. This imbalance may cause the system frequency to drop rapidly, too fast for the generators on the system to respond. Or, under some cases, there may not be enough reserve generation on the system to match the amount of generation lost. In order to maintain the frequency stability of the system, the UFLS relay will drop groups of load in order to rebalance the system. Demand Side Management is typically used to help smooth peak loads by switching off loads such as water heater heaters, air conditioners, and other interruptible loads. The DSM functionality may help keep power costs down by avoiding the use of more expensive generation during system peaks for utilities that have to operate such expensive generators to meet the peak demands and by delaying the need date for new generation capacity.

Figure 4-1
Island Power System



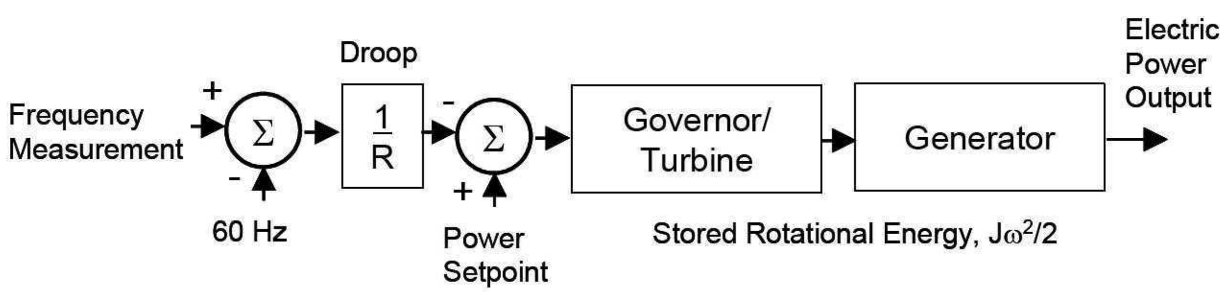
The frequency of the voltage in an AC power system is related to the rotational speed of the interconnected conventional generating units. A schematic of a conventional generating unit is shown in Figure 4-2. For a 60 Hz system, the synchronous machines used in fossil-fired plants typically turn at either 1800 or 3600 Revolutions per Minute (RPM). Since this speed is so high, there is a large amount of energy stored in the machine rotors which is related to the inertia of the machines time the square of the rotational speed. These machines are subject to slight changes in speed determined by what power engineers refer to as the "swing equation" where:

$$\text{Change in Generator Speed} = \frac{\text{(Mechanical Power Input – Load Electric Power Output)}}{\text{(Speed x Rotating Inertia)}}$$

For an increase in load, the generator instantaneously responds by decreasing frequency. If there is a decrease in load the machine instantaneously responds by increasing frequency. The amount of this frequency change is inversely related to the rotational inertia of the machine. In large power systems the equivalent rotational inertia of the interconnected conventional generators is very high, so the speed deviation is extremely small. However for an island power system with a smaller amount of conventional generation, the equivalent inertia is much smaller, which means much larger deviations in frequency.

As load varies, there are two types of feedback shown in Figure 4-2 that are used to readjust the power input into the generator to help maintain the generation/load balance. The fastest feedback mechanism utilizes frequency measured locally at the machine to adjust the mechanical power input into the generator. The amount of compensation is proportional to a regulation constant which is also referred to as the "droop" compensation. If frequency drops due to a net load increase, the droop response will increase mechanical power input to the machine to compensate. If frequency increases due to net load decreasing, the droop response will decrease mechanical power input. The speed at which this droop response occurs depends on the type of machine. For a steam machine this would relate to the time needed to open or close a valve. For a diesel generator, this is related to the time needed to adjust fuel flow.

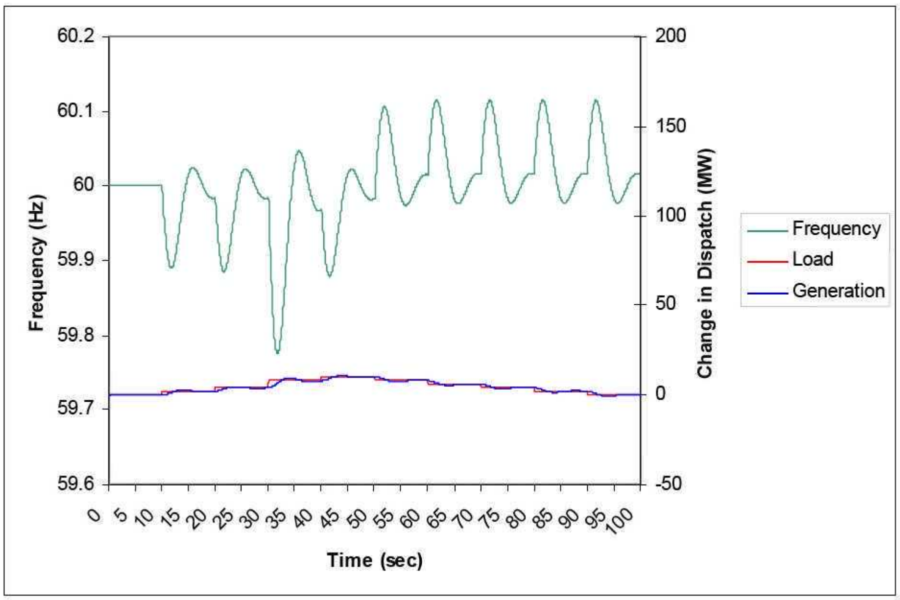
Figure 4-2
Conventional Generator Controls



There is a second feedback path involving the adjustment of the Power Setpoint shown in Figure 4-2. For a dispatchable unit, this setpoint is adjusted by the centralized Automatic Generator Control. For a nondispatchable unit, this setpoint has to be adjusted locally (oftentimes manually). For a dispatchable unit, the AGC will coordinate the setpoint of all of the dispatchable units to drive the average frequency deviation to zero. Note that this feedback from the AGC has a time delay associated with it, so that the initial response to changes in load is more a function of the rotational inertia of the machine and the droop characteristic.

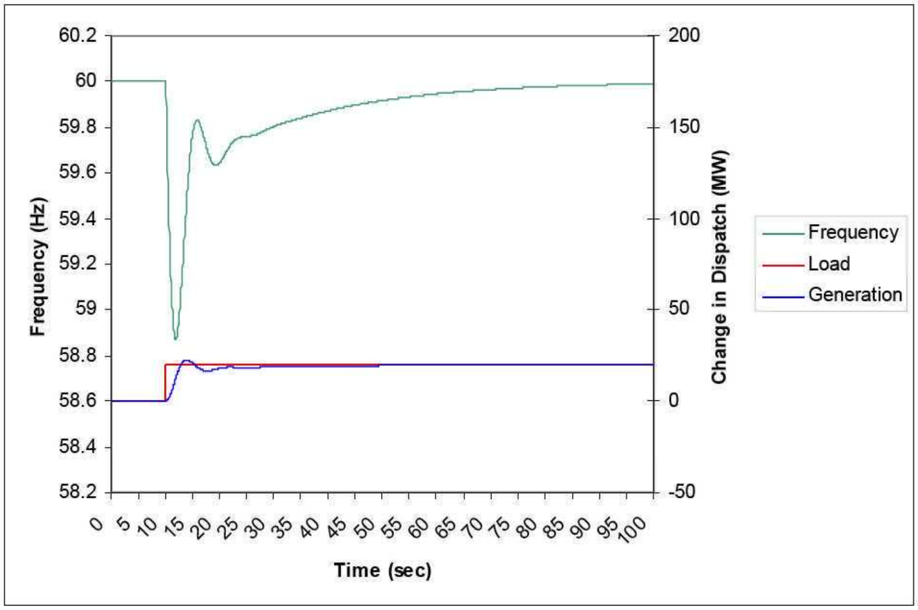
A simple computer simulation based on Figure 4-2 can be used to illustrate how generation responds to various disturbances. For normal upward and downward variations in load, one can see that the response results in a slight modulation of the frequency in Figure 4-3. The load in this case varies in one percent increments, and a spike in frequency occurs at these transitions. A combination of droop response and AGC feedback pulls the frequency back to 60 Hz. Note when load increases that frequency dips temporarily and when load decreases the frequency jumps temporarily.

Figure 4-3
Frequency Deviation due to Normal Load Change



Now suppose there is a large loss of generation on the system, perhaps due to the trip of a single unit, which results in the loading on the rest of the generators to increase. This will cause a jump change in generator loading as illustrated in Figure 4-4, where in this example a 10 percent loss of generation is modeled. Note that the system frequency plummets to a value determined by the equivalent system rotating machine inertia and droop characteristic. If the remaining generators have enough capacity, eventually the frequency is brought back to 60 Hz through the coordinating efforts of the Automatic Generator Control. Note if there is not enough remaining system capacity or system inertia, that the frequency could drop so low that stability cannot be maintained and a blackout could occur.

Figure 4-4
Frequency Deviation due to Loss of System Generator



Each machine has a maximum rated output and oftentimes a minimum output. Note that when a machine is operating at its maximum rated output that it has no regulating reserve to help compensate for decreases in frequency via its droop response. When it is at its minimum output, it cannot help compensate for increases in frequency either. In order to help maintain frequency, there needs to be both an upward and downward regulating reserve capacity. On a system wide basis, this margin is also referred to as regulating reserve requirements.

For most systems, the online reserve capacity must be able to handle more than just normal apparent load change. Spinning reserve must also be able to compensate for the loss of generation due to a unit trip illustrated above or loss of a transmission link. The reserve is called "spinning" since the reserve margin must be associated with units that are currently online and synchronized to the power system. If an event occurs that results in a large loss of generation, the system frequency could collapse before additional units can be brought online. The amount of spinning reserve needed at any given time is usually determined through running computer simulations of various operating contingencies. [However, as a fuel-savings measure, HELCO and MECO do not carry spinning reserve capacity. Instead the reserve requirements are determined by the anticipated sub-hour variations in apparent load (the variation in anticipated actual demand plus the variation from variable generation sources such as wind and solar. Spinning reserve has a penalty in cost because it requires generators to operate at lower outputs where they are less efficient. A loss of generation or major transmission outage at HELCO and MECO will often result in outages from underfrequency load-shed.]

In the event that the system generators cannot respond fast enough to a large block loss of generation or if there is not enough spinning reserve to cover loss of the generation, then the last line of defense against frequency collapse is under frequency load shedding. As the frequency drops to certain values, relays are used to trip off blocks of load in an attempt to balance the electrical load to the available generation. Typically the load shedding is set up in tiers, where a certain amount of load is shed in blocks. For an island system which experiences large reductions in frequencies, these tiers could start at around 59 Hz. An example of tier setpoints could be:

- First Tier – 59 Hz (Start with Noncritical load if available, such as well pumps)
- Second Tier – 58.5 Hz
- Third Tier – 58 Hz
- Fourth Tier – 57.5 Hz
- Fifth Tier – 57 Hz

The use of underfrequency load shedding will disrupt customer load, but the alternative could be a collapse of the entire system. It should be noted that as DGs are added to circuits used in the UFLS scheme, the amount of load that can be shed is reduced, thereby reducing the effectiveness of the UFLS scheme. This in turn may require additional load to be added to the UFLS scheme to make up for the difference.

The discussion above focused mostly on the issues regarding the regulation of frequency, since that is usually a key limiting factor in the stability of island power systems. It should be noted that generators are also used to maintain system voltage as well. This is done through the use of generator excitation systems to regulate the terminal voltage. Various contingencies such as the tripping of a unit or loss of a transmission line could result in system voltage instability as well. Voltage control issues are also identified through the use of computer simulation studies.

4.1.2 Impact of Renewable Generation on System Reliability

There are two different types of values associated with electric generation. The first is the delivered energy value (kWh) which can be directly measured. The second is a capacity value related to the ability of the generation to support system reliability. This reliability capacity value is not directly measurable, but needs to be quantified through a systems analysis. The impact of renewable generation on overall system reliability is highly dependent on the technology utilized. This section will discuss various characteristics of renewable generation in contrast to conventional fossil-fired generation, and the impact these differences have on system reliability. The key characteristics to be discussed include:

1. Intermittency – rapid fluctuations during daily cycle
2. Frequency Regulation – response that help "smooths" frequency variations
3. Ride Through – ability to remain connected during system disturbances
4. Dispatchability – capability of being operated at a centrally-controlled power setpoint
5. Curtailability – ability to reduce output of renewable source on demand
6. Peak Contribution – amount of contribution to meeting peak load demand
7. Non-Peak Contribution – amount of peak load from renewable to be accommodated at nonpeak system conditions
8. Local Impacts – impact on feeder to which source is connected

Note that the ordering of the impacts listed above does not correspond to any type of ranking. The impact of each factor on system reliability depends on the system to which the renewable is to be integrated.

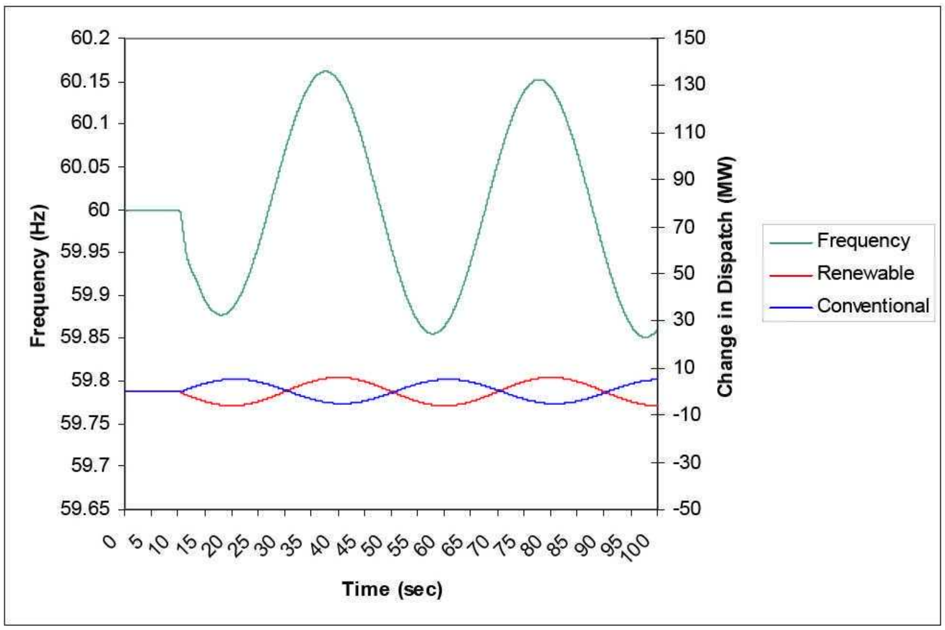
4.1.2.1 Intermittency

Intermittency refers to rapid fluctuations in the power output of a renewable source due to fluctuations in the primary source of power. For wind generation this could be caused by gusts and for photovoltaic generation this could be caused by variable cloud cover. These variations can occur on the order of seconds, involving fluctuations from peak output to zero output within a timeframe of minutes. Variations in renewable generation must be counterbalanced by variations in the conventional fossil-fired generation output. Renewable generation intermittency puts additional wear and tear on the conventional generation and will result in frequency deviations as well. Figure 4-5 shows the impact of intermittency of a renewable source on both the frequency and the output of the conventional generation. Note that any change in renewable net output needs to be counterbalanced by a change in conventional generation. One way to accomplish this is to add greater upward and downward regulation capacity in the conventional generation to accommodate intermittent renewable sources. However, this will increase operating costs and may also result in over-production during minimum load which would require additional curtailment of variable renewable sources. Other regions in North America are using wind and/or solar forecasting, as now in place at the California Independent System Operator, the Electric Reliability Council of Texas and the New York Independent System

Operators. Such forecasting, if properly designed, will help with advance scheduling of other generating units. Still another means to avoid increased variability is to require variable renewable resources to be coupled with energy storage devices which would reduce the variable power output delivered to the utility system.

The illustration also shows that the intermittent nature of the renewable source will contribute to frequency deviations as well. If the intermittent renewable source makes up a large percentage of the total generation mix, then the frequency can actually dip to a level that could trigger under frequency load shedding or the tripping of IEEE 1547 compliant distributed generation devices.

Figure 4-5
Frequency Deviation due to Renewable Intermittency



4.1.2.2 Frequency Regulation

Frequency regulation refers to the ability of the renewable generation source to contribute to frequency control. A conventional generator has both rotational energy stored in its rotor plus a droop characteristic to help support regulation of system frequency at 60 Hz. Whenever there is a change in the load or generation due to a unit drip, then generating units with frequency regulation capability rapidly adjust their outputs to compensate. The contribution of each frequency regulating unit is generally related to their rated capacity.

Renewable technologies typically do not support frequency regulation. Generally the operating goal for a renewable generation control is to maximize the conversion of power without overloading the device. So during a frequency variation, the power output would generally be kept constant. In order for a renewable source to have a frequency regulation capability, it would need to have the ability to store energy similar to the way a conventional generator stores energy in its rotational mass and also a means of adjusting its power output in response to changes in frequency. This "droop" characteristic response would boost injected power when frequency drops and decrease injected power when frequency rises. Frequency regulation can be added to large scale renewable projects through the modification of controls and the addition of energy storage. However, this is normally not economical for the smaller units.

The lack of frequency regulation capability places a limit on the percent of generation that can come from certain renewable sources. For a system to operate reliably, there needs to be enough of the right type of generation to help control frequency in the event of the instantaneous loss of the largest unit. In a system with 100 percent conventional fossil-fired generation, than loss of a single generator would be supported by the other 90 percent of the generation. If that same system had a mix of 80 percent conventional with 20 percent renewables with a technology that did not have frequency regulation capability, then loss of a 10 percent would only be supported by the remaining 70 percent of the generation. Adding renewables to the generation mix in this sense leads to larger frequency deviations after operating contingencies since the remaining machines have a limited frequency regulation capability. At some point, the amount of non-frequency regulating renewables needs to be capped, otherwise loss of a large conventional unit could result in underfrequency load shedding and possibly a system collapse.

4.1.2.3 Ride Through

Ride through refers to the capability of a renewable generation source to "ride through" disturbances in voltage or frequency. For many North American systems, the penetration of renewable sources has not grown to be large enough where ride through is an issue, since the penetration levels are still relatively small. However for an island power system, it is important to have large renewable sources capable of riding through certain disturbances since, especially if make up a significant portion of the generation mix.

The inability of a renewable resource to ride through a disturbance means that its capacity cannot be counted on in the aftermath of certain operating contingencies. If a loss of a large generating unit causes frequency to decrease below a critical point, then renewables without ride through will trip, aggravating the situation. To compensate for this lack of ride through, then additional conventional generation spinning reserve needs to be set aside to account for loss of a single large unit plus amount of renewable generation without ride through capability.

There is a trend to require ride through functionality on large renewable generation projects. This is already being specified for wind farms and there are options being looked at applying this requirement to large photovoltaic installations as well.

4.1.2.4 Dispatchability

Dispatchability refers to the capability of controlling the power output setpoint of a renewable generation source and being able to count on a constant output at that setpoint. For a conventional fossil-fired generation source, the power setpoint is related to steam flow or fuel flow, and output is relatively easy to adjust. However for certain renewable sources, if the energy source is variable, such as wind or solar, then the output could be difficult to control.

In a system without renewable sources, the selected generation sources are continuously dispatched to track changes in load. When renewable generation is integrated into the grid, the problem becomes more complex, because now the dispatch not only needs to account for changes in load, but changes in renewable generation output as well. It is necessary to have a certain amount of dispatchable generation capacity available to properly compensate not only for a change in load, but also for a change in the renewable generation output.

4.1.2.5 Curtailability

Curtailability refers to the ability of reducing the output of a renewable source via a command from a central controller. This command would signal the renewable generator to limit operation as to not exceed a percentage of its rated output. There are several reasons why this capability is useful. First, if the renewable generation output is become highly intermittent due to weather conditions, the system may not have enough of the right generation capacity to compensate. This may be due to a conventional generator which normally contributes to regulation being down for maintenance. In that that case, it may be necessary to cap the output of the renewable generation in the interest of overall system reliability.

Another scenario in which it may be necessary to cap the output of a renewable source is if there is not a large enough percent of conventional generation available or generation that is capable of supporting system reliability in the overall mix. Suppose at a given point in time, that all renewable sources are operating at peak and the percent mix of conventional generation is too low, due to a light loading condition. Then it may be necessary to curtail the renewable generation in order to allow a higher percent of the conventional generation.

Curtailment is relatively easy to implement for large projects, because it is cost effective to establish the necessary communication link and process controller. However for the smaller, distributed units, this would not likely be cost effective. The result for high penetration of the smaller distribute units is that during times when curtailment is required, the large renewable generation with typically lower costs would be curtailed ahead of the smaller renewable generation which do not have the necessary communication link. In addition, high penetration of the smaller renewable generation can reduce future opportunities for addition of large-scale renewable resources when may offer superior system benefits at lower costs.

4.1.2.6 Peak Contribution

Peak contribution refers to the percent of its capacity that the renewable generation source will be likely to deliver coincident with the system peak. This varies depending on the renewable technology. For example, photovoltaic generation can contribute 50-70 percent of it capacity to typical load peaks that occur late in the afternoon. The island system is typically most susceptible to reliability problems during the system peak. At this time most of the conventional generation has been dispatched and operating near its limits. In this case, there is very little reserve capacity left to compensate for loss of a conventional unit or variations in renewable generation output.

It is highly desirable for renewable units that have significant peak contribution capability to also have ride through and curtailment functionality. If a disturbance occurs, the ride through will permit the renewable generation device to continue to contribute to meeting system demand. If there is intermittency in the output due to weather patterns, the unit can be curtailed so that it does not put additional burden on the reduced regulating margin at peak.

4.1.2.7 Non-Peak Contribution

Non-peak contribution refers to the maximum capacity that the renewable generation source can deliver to the system, which is not likely coincident with the system peak. For example, photovoltaic generation will peak at mid-day, around 1 p.m. in the afternoon. In order to accommodate integration of the renewable generation, there needs to be a corresponding decrease in the conventional generation. Renewable generation output can be accommodated to a certain point, but there needs to be certain minimum amount of conventional generation online to provide frequency and voltage regulation support. Having too high a percent of renewable generation online during off-peak scenarios can also degrade reliability. Another consideration is that conventional generation must also be run at a minimum output. So during an off-peak condition if the amount of renewable generation is high, this may force the conventional generation used to regulate the system to operate too close to their lower output limits.

4.1.2.8 Local Impacts

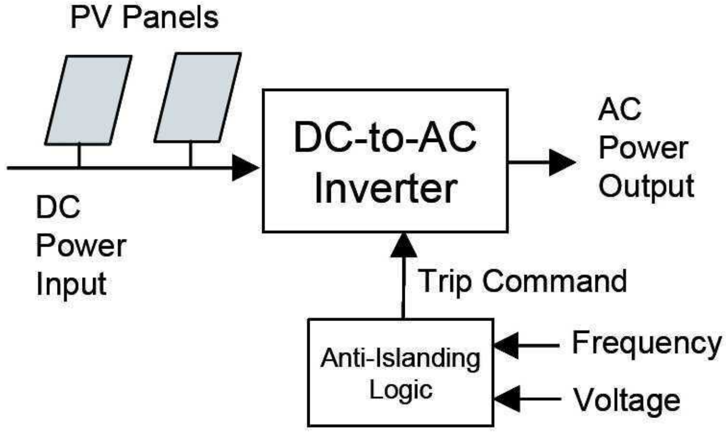
Local impacts refers to the fact that the renewable generation could impact the immediate section of the circuit it is connected to. This is especially true of renewable generation that is interconnected at the medium-voltage distribution level. Distributed generation on a given feeder that exceeds 15 percent of the peak load could require changes in the protection and voltage regulation of the circuit.

Distributed renewable generation is also susceptible to trips due to the operation of protection equipment. A fault occurring on the feeder could cause the main feeder breaker to trip, isolating the renewable sources on that circuit from the transmission grid.

4.1.3 Potential Impact of IEEE 1547

In the past, most all of the generation was connected directly to the high-voltage transmission system. However technology has made it possible to also interconnect small and intermediate-sized generation at the medium voltage distribution level. Many of the distributed generation sources make use of a DC-to-AC inverter as opposed to being based on rotating machine technology like conventional fossil-fired generation. A simple schematic of a photovoltaic system is shown in Figure 4-6. Photovoltaic panels convert sun energy into DC power. This DC power is converted into AC power by a power electronic inverter. This type of unit does not have an inertia like a rotating machine, unless it could be simulated by having some type of internal energy storage. Also there is typically not a droop characteristic which would adjust power output as frequency changes.

Figure 4-6
Photovoltaic Generation System



The standard often utilized by North American utilities for regulating this interconnection is IEEE Standard 1547 – *IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems.* IEEE 1547 describes what is required as far as the protection and control of a distributed generating device in order to safely connect it to the power grid. A complimentary certification has been developed by Underwriters Laboratories called UL 1741 – *Inverters, Converters and Interconnection System Equipment for Use with Distributed Energy Resources*. Much of the small and intermediate scale distributed generation equipment being deployed nowadays is built to comply with the IEEE 1547 and UL 1741 standards. The objective of the IEEE 1547 standard is to produce a relatively simple and thus low-cost design that will not adversely impact the power quality on the distribution circuit to which it is connected. These standards were not developed to consider the overall impact on the power system beyond the distribution circuit and do not address high penetration levels. The negative impacts of a high penetration of generation connected with the minimal IEEE 1547 standards on power systems has need identified by the industry, including NERC, as a near-term reliability concern due to the rate at which distributed generation is being installed on power systems in North America.

The standard states that the distributed resources shall not regulate the voltage at the point of common coupling. Also the unit shall not cause the service voltage to go outside the standard voltage ranges (ANSI C84.1-1995 Range A) which is typically 95 – 105 percent of the nominal voltage. The standard also puts limits on the amount of harmonics the unit can inject into the power system.

The IEEE 1547 standard also requires distributed generation devices to automatically isolate themselves from the power grid if the distribution system to which it is connected is "islanded" from the main grid or faulted. This satisfies an important safety issue in that the unit will be disconnected from the grid if utility personnel need to work on the medium voltage distribution system after the disturbance. Otherwise there is a potential risk for electrocution. In addition, it prevents damage that could occur to customer and utility equipment if the distributed generation remained operational in an unintended islanded situation with abnormal voltage and frequency conditions. This grid fault response/isolation functionality is specified in terms of abnormal voltage and frequency limits for which the unit must trip, as illustrated in Tables 4-1 and 4-2. The trip levels for voltage are shown in Table 4-1 whereas the trip levels for frequency are shown in Table 4-2. Note that for frequency, the IEEE 1547 states that limits can be adjusted for units larger than 30 kW to better coordinate with the power system and provide ride-through capability for events such as loss of a large generating unit. However, if such expanded frequency settings are implemented, an alternate anti-islanding scheme must be employed to ensure that the DG will trip offline when the distribution circuit opens.

Table 4-1
IEEE 1547 Voltage Setpoints

Voltage Range (Percent of nominal voltage)	Clearing Time (seconds)
V < 50 %	0.16
50 % ≤ V < 88 %	2.00
110 % < V < 120 %	1.0
V ≥ 120 %	0.16

Table 4-2
IEEE 1547 Frequency Setpoints

DR Size	Frequency range (Hz)	Clear Time (seconds)
DR ≤ 30 kW,	F > 60.5	0.16
	F < 59.3	0.16
DR > 30 kW	F > 60.5	0.16
	F < 59.8 – 57 (freq threshold adjustable depending on application)	0.16 – 300 (time threshold adjustable depending on application)
	F < 57.0	0.16

The IEEE 1547 underfrequency limit for distributed generation devices below 30 kW is 59.3 Hz. This means that if a large frequency deviation occurs on the power system due to events such as a conventional unit trip, wind ramp, or system fault, then a secondary trip of all distributed generation connected in accordance with the trip setting provided above will quickly follow. So instead of helping to support the system frequency, the distributed generation by tripping off-line would worsen the imbalance of system load and generation and could contribute to a lower frequency dip. Historically, transmission-side generation has been designed to remain connected until the underfrequency load shedding has had a chance to operate. For an island power system, this tripping may not occur until 59 Hz. Another scenario where distributed generation could be disconnected is during system disturbances that cause voltage to drop below 50 percent at their point of interconnection. System voltage drop is a localized effect, whereas frequency is seen system wide.

A comprehensive set of detailed simulations would need to be run for a given island, with conventional and distributed generation modeled in more detail, to quantify the impacts of distributed generation on the existing underfrequency schemes and system reliability. However, this does point to the fact that the addition of a large number of small to medium-sized distributed generation units based on the minimum IEEE 1547 standard trip settings would impact system reliability on island power systems. This issue is recognized by NERC as a reliability concern for the North American power systems. The issues is more significant for island grids because the system frequency varies to a greater extent than large systems and it is possible for additional imbalance to make the system unstable by rendering the existing underfrequency load shed scheme ineffective.

The ability of a distributed generation resource to stay connected during frequency and voltage disturbance is defined as “ride through” capability. There is a trend to require ride through capability for large-scale distributed generation projects, such as wind parks or large PV installations. HECO, MECO, and HELCO require expanded ride through for their large-scale transmission renewable projects to coordinate with their underfrequency load shed scheme. HELCO has also required this for distributed generation projects such as a 500 kW PV installation on its system. However, many distributed generation projects have been installed on the HELCO system that are larger than 30 kW but have not been required to have expanded ride through capability. The ride through characteristics are typically defined by separate voltage and frequency ride through curves as shown in Figures 4-7 and 4-8 for an example large-scale PV station. The frequency limits would be set to coordinate with the under frequency load shedding. Note that there could also be an optional droop characteristic built into the station’s power output control to emulate a droop characteristic of conventional generation. However, expanding the voltage and frequency settings may require an alternate anti-silanding scheme, which may add to the expense of the project and may also be difficult to achieve with standard products which are designed for typical requirements and/or mainland systems. Similarly, expanded grid-support capabilities may also require additional costs.

Figure 4-7
Voltage Ride Through Characteristic

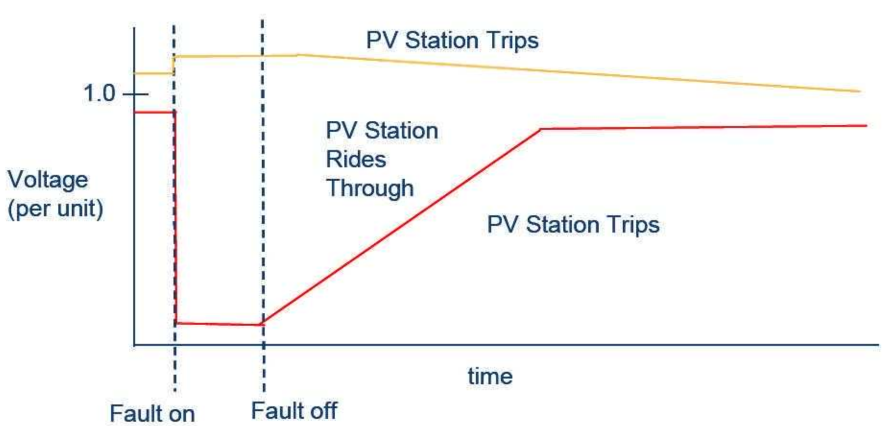
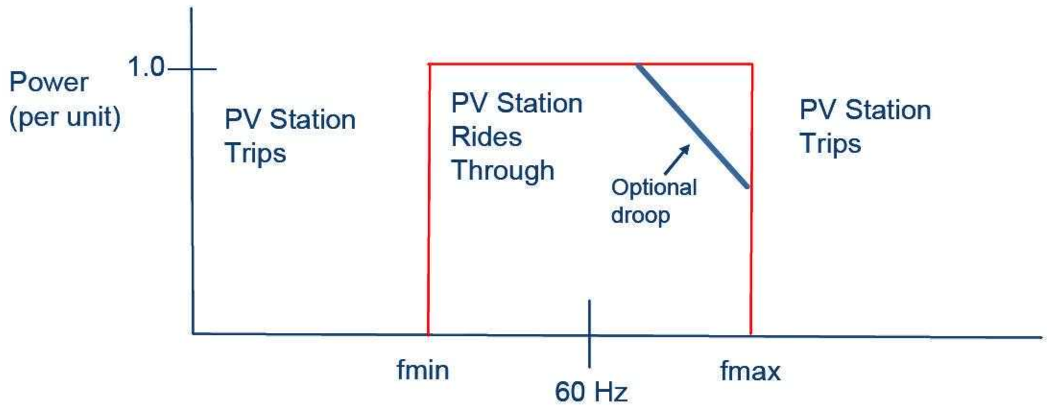


Figure 4-8
Frequency Ride Through Characteristic



4.1.4 Differences between Hawaiian Island Systems

Substantial differences exist among the various Hawaiian Island systems with regard to system peak load, conventional fossil-fired generation capacity and amount (and types) of renewable generation as illustrated in Table 4-3. As discussed in the previous section, the impact of renewable generation on reliability is dependent on the percentage penetration with respect to the amount of load to be served and the regulating generation margin available to account for various operating contingencies. Because of this for example, 1 MW of new photovoltaic capacity on the island of Lanai would have a much larger relative impact than that same amount of generation placed on Oahu. As far as the integration of more renewable generation, this integration would be more problematic on islands that already had a large penetration of renewables, since the percentage of regulating generation would already be lower. It is for these reasons that caps to be considered on renewable generation sources need to be set independently for each island dependent on the size of the system, existing level of renewable generation and renewable technology.

For one or more specific islands, the cumulative maximum generating capacity for a given technology type with minimal grid-friendly capabilities (such as low-voltage/low-frequency ride through) may have already been reached. If this is the case, no additional capacity of that technology type may be connected under the FIT until system operators certify that the system can reliably accept the associated power output. In this instance, the incremental limit on renewable capacity for that technology type is zero for those islands.

Table 4-3
HECO Peak Loads and Resources by Island - 2007

Island	System Peak Load (Mw)	Generating Capability	
		System Capability at Peak Load (Mw)	Largest Unit (Mw)
Oahu	1,241.0	1,672.1	140.0
Maui	209.3	265.7	37.6
Lanai	5.46	9.4	2.2
Molokai	6.35	12.0	2.2
Hawaii	203.3	269.9	21.4

Table 4-4
Renewable Penetration by HECO Companies – As of 12/31/2007[24]

Company	% Energy from Renewable Sources
HECO	11.0%
HELCO	39.7%
MECO	24.7%
Total	16.1%

[24] The percentage levels include renewable and energy efficiency sources as reported in the HECO Companies' 2007 Corporate Sustainability Report.

5. Appendix B: Experience with FITs in Europe and the United States

FITs have been adopted widely around the world. Outside of the United States, 37 countries have adopted FITs as of 2007, making the FIT the most prevalent renewable energy policy globally.[25] Although FITs have begun to emerge in North America[26], the principle laboratory for FIT development has been Europe, where 18 European Union (EU) countries[27] and several members of the broader European Energy Community[28] have adopted FIT policies (Figure 1). The structure and performance of the leading European FITs was previously summarized in a White Paper prepared for the State of Hawaii in support of the Hawaii Clean Energy Initiative.[29] This Appendix more broadly reviews European experience with FITs to date. In addition, several issues of interest to HECO, such as the methodologies used to determine policy caps and set FIT rates in included in Appendix C.

5.1 European Experience

FITs were first introduced in Europe in the late 1980s and early 1990s in Denmark and Germany. These early FITs guaranteed interconnection to renewable energy generators and also guaranteed that generators would be paid a premium price. In both countries, the guaranteed payment was based on a percentage of the average retail price. The FIT rate was therefore higher than wholesale rates, but the payment levels varied with the retail rate over time. When retail rates decreased in the late 1990s, it became more difficult to develop renewable energy projects. A second challenge with the German and Danish FITs was that,

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25 Martinot, E. (2008). Renewables 2007 global status report. Paris, France and Washington, DC: Renewable Energy Policy Network for the 21st Century (REN21) and Worldwatch Institute.

26 Three Canadian provinces – Ontario, Prince Edward Island, and British Columbia – have adopted FITs. See Gipe, P. (2007). Renewables without limits: Moving Ontario to Advanced Renewable Tariffs by updating Ontario's groundbreaking standard offer program. Toronto, ON: Ontario Sustainable Energy Association; BC Hydro. (2008). Standing Offer Program Rules. Vancouver, BC.

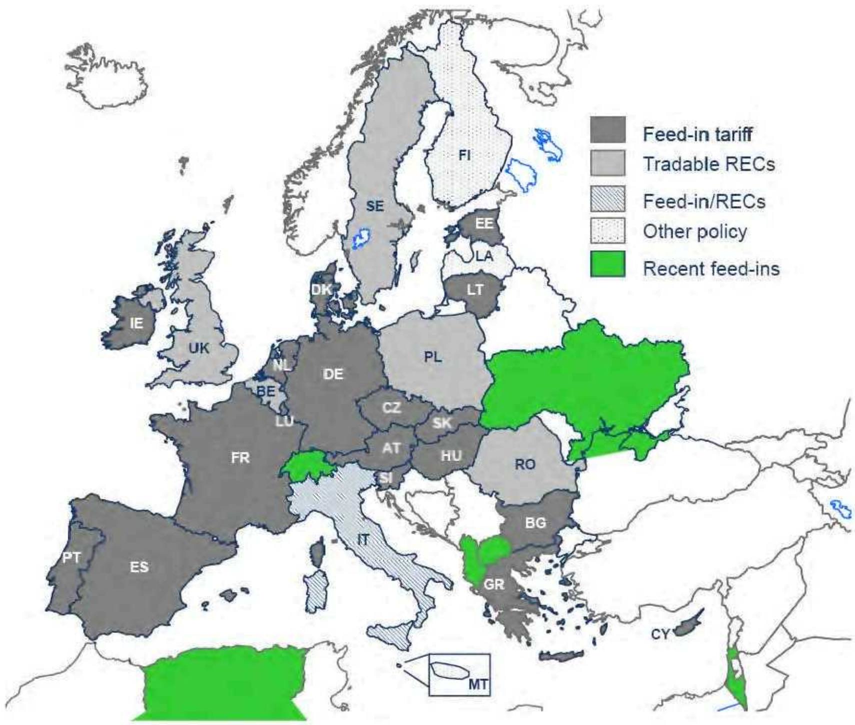
27 Klein, A., Pfluger, B., Held, A., Ragwitz, M., & Resch, G. (2008). Evaluation of different feed-in tariff design options - Best practice paper for the International Feed-in Cooperation (2nd ed.). Karlsruhe, Germany and Laxenburg, Austria: Fraunhofer Institut für Systemtechnik und Innovationsforschung and Vienna University of Technology Energy Economics Group

28 Such as Switzerland, the Republic of Macedonia, Albania, and the Ukraine. See Gipe, P. (2008). Swiss adopt aggressive feed law for renewable energy. RenewableEnergyWorld.com Retrieved August 8, 2008, from http://www.renewableenergyworld.com/rea/news/story?id=53026; see also Energy Community Secretariat. (2008). Report on the implementation of the Acquis under the Treaty Establishing the Energy Community. Vienna, Austria; see also Konechenkov, A. (2008). Ukraine adopts green tariff. Bonn, Germany: World Wind Energy Association.

29 Hinrichs, D. (2008). Feed-in tariff case studies: A White Paper in support of the Hawaii Clean Energy Initiative. Bethesda, MD: SENTECH, Inc. Prepared for the U.S. Department of Energy and the State of Hawaii.

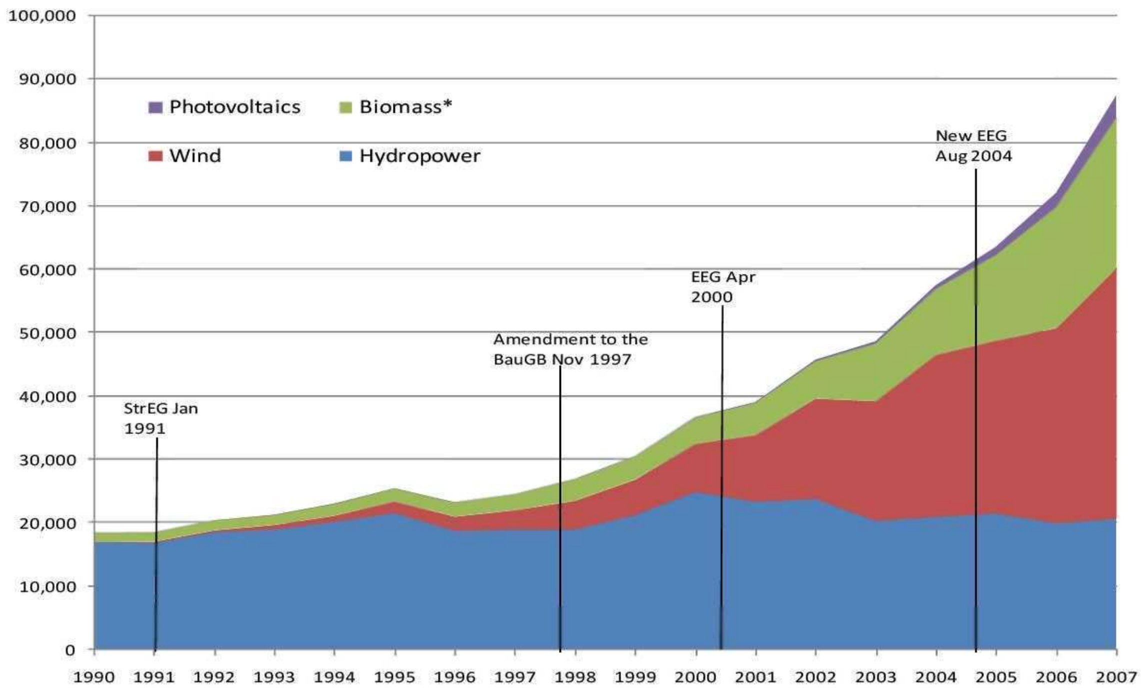
while they encouraged rapid wind energy market growth, they provided little incentive to other generator types because the payments were too low.

Figure 5-1
National Renewable Energy Policies in Europe



In 2000, the German government enacted a new FIT law that addressed the perceived shortcomings of the original policy. The new law guaranteed renewable generators both interconnection and a fixed price payment for 20 years. The 2000 FIT also differentiated between different technologies, such that wind and photovoltaic generators received different payment levels. The payment levels were designed to reflect the generation costs of specific technologies and provide investors with a reasonable profit. As can be seen in Figure 3-2 below, the 2000 FIT, and its subsequent 2004 amendment, triggered rapid and sustained renewable energy market growth in Germany. In 2007, Germany supplied 14.2 percent of its national portfolio from renewable energy, exceeding its 2010 goal of 12.5 percent three years ahead of schedule.

Figure 5-2
Renewable Energy Generation in Germany in Gigawatt-Hours (1990-2007)



Source: BMU, 2008

By the end of 2007, Germany had 22,622 megawatts (MW) of wind and 3,800 MW of solar PV capacity installed, with 1,667 MW of wind and 1,100 MW of PV added in 2007 alone.[30]

The second largest renewable energy market in Europe after Germany is Spain. Spain also enacted a FIT based on generation cost in the late 1990s. One of the key differences between the Spanish and German FITs is that Spain allows generators to either choose a tariff similar to Germany's or to choose a premium which sits atop the market price. By the end of 2007, Spain

[30] European Wind Energy Association. (2008). Wind map 2007. Retrieved August 8, 2008, from http://www.ewea.org/fileadmin/ewea_documents/mailing/windmap-08g.pdf *See also* Bundesverband Solarwirtschaft. (2008). *Statistische Zahlen der deutschen Photovoltaikbranche*. Berlin, Germany.

had installed 15,145 MW of wind capacity, and 500 MW of PV capacity.[31] During 2007, Spain's wind capacity additions set a European record, with 3,522 MW installed in a single year, and Spain's PV market grew by over 300 percent.

European analyses have generally affirmed the FIT's success. The European Commission[32] and the Stern Report on the Economics of Climate Change[33], for example, each concluded that FITs are not only the most effective policy in Europe to date, but that they are also the most cost-effective as well. The primary reason for this is that FITs minimize investor risk and therefore reduce financing costs. A recent International Energy Agency study of renewable energy policy concluded that incentives that reduce investor risk, such as FITs, can lower renewable energy costs by 10 to 30 percent compared to other policy structures.[34]

The example set by Germany and Spain has inspired a broad range of other European countries to adopt FITs. The designs of each of these national FITs are different, and many of these policies have not yet driven rapid renewable energy market growth.[35] FITs continue to diffuse around the region, however. In 2008, both Switzerland and Israel added new FIT legislation based on the generation-cost approach used by both Germany and Spain. Also in 2008, the UK announced that it would create FITs for resources 5 MW and under, rather than relying solely on tradable renewable credits. The UK followed Italy's lead in developing a hybrid policy framework that uses FITs to target certain resources (in Italy, FITs support PV), and tradable credits to target other resources.

[31] Ibid. European Wind Energy Association (2008); *See also* Salas, V., & Olias, E. (in press). Overview of the photovoltaic technology status and perspective in Spain. *Renewable and Sustainable Energy Reviews*

[32] Commission of the European Communities. (2005). *The support of electricity from renewable energy fsources*. Brussels.

[33] Stern Review. (2006). Policy responses for mitigation: Accelerating technological innovation (Part IV, Chapter 16). In *The economics of climate change*. Cambridge, UK: Cambridge University Press.

[34] de Jager, D., & Rathmann, M. (2008). *Policy instrument design to reduce financing costs in renewable energy technology projects*. Utrecht, the Netherlands: Ecofys International BV. Prepared for the International Energy Agency, Renewable Energy Technology Development

[35] A detailed catalogue of feed-in tariff issues and options, which discusses most of the design choices deployed in Europe, was recently published by the California Energy Commission; *see* Grace, R., Rickerson, W., Corfee, K., & Porter, K. (2008). *California feed-in tariff design and policy options* (CEC-300-2008-009-2D, Second Draft Consultant Report). Sacramento, CA: California Energy Commission

Europe has played a leading role globally in engineering and managing rapid renewable energy market growth, and European experience could serve as a useful benchmark for Hawaii as it moves forward with its FIT development. Appendix C provides a summary of European practices related to the following topics:

- Technology categories under European FIT systems;
- Caps under European FIT programs; and
- Procedures and methodologies to set FIT rates in Europe.

As discussed in Appendix C, there are a broad range of technology categories that have specific cost-of generation tariffs under European FIT programs. In Germany, for instance, there are more than 60 tariff categories currently in place. Tariffs are typically differentiated by technology type, project size and location.

FITs in Europe were initially established to be open-ended, i.e. the total subsidy was not limited by law or regulation. However, in recent years, we've budget limits or caps have been established in some countries to limit the total subsidies under the FIT systems. For instance, the Netherlands now has a system in place where they establish caps either by setting production ceilings by technology or through a competitive bid tender process. In Spain, the law permits tariff review and adjustment if the previously established capacity goals are achieved.

As displayed in Table 5-1, Europe has two types of feed-in systems, the FIT and the feed-in premium, which sits on top of the market price. Both the Netherlands and Germany have a FIT system, while Spain offers both types of tariffs. Generators in Spain can choose between either of these two options on an annual basis. FITs and FIT premiums are based on the quantity of electricity supplied to the grid. In the different European cases, the support level is coupled with production volume, expressed in kWh. Under FITs, production costs plus a reasonable profit level are used to calculate compensation. In addition, other costs outside the sphere of influence of the producer, such as societal costs, can be included.[36]

With respect to the procedures and methodologies used to set tariffs in Europe, the process is a highly data intensive process that involves collaboration from government entities, independent third-party consultants, research institutions and industry stakeholders. Typically, there is

[36] see website http:// http://www.externe.info/ for more information on cost of externalities

extensive research into the cost of generation for the different technologies. In addition, many countries also conduct extensive stakeholder interviews to determine reasonable profit levels by technology type and project size. The proposed tariffs usually go through an extensive review process by both the government and the public. Eventually, a governmental entity approves the recommended FIT levels. The contract length, or duration of the FIT subsidy, ranges from 12 to 20 plus years, depending on the life of the system.

Table 5-1
Properties of FIT Systems in Europe

	Netherlands	Germany	Spain-FIP	Spain-FIT
FIT (FIT) or premium FIP	FIT	FIT	FIP	FIT
Categories for technology/fuel combination	Yes	Yes	Yes	Yes
Categories for size of installation	Yes	Yes	Yes	Yes
Stepped tariffs	Yes	Yes	Yes	Yes
location specific tariff for wind	Yes	Yes	No	No
Duration of subsidy (years)	12-15	20[37]	lifespan of installation	lifespan of installation
frequency of renewal of tariffs (years)	1	4	1	4
delay in renewal of tariffs (years)	2	-	2	2
Budget maximum	Yes	No	No	No
Digressional tariffs	No	Yes	No	No
additional stimulation within FIT/FIP	Yes	No	Yes	Yes
category for co-firing biomass	Yes	No	Yes	Yes
category for waste incineration installations	Yes	No	Yes	Yes

In both the Netherlands and Spain, the premium tariffs are set annually for the next two years. The fixed tariffs in Spain and Germany are reviewed once every four years. To account for technology innovation and resulting reduced cost of generation, Germany's tariffs digress over time.

5.2 Conclusions for Europe

The following conclusions can be made regarding the FIT market in Europe:

- ***Long-term, generation-cost-based payments can rapidly grow renewable energy markets and achieve ambitious goals.*** In Europe, incentives set according to

[37] For some categories, also 15 or 30 years

generation cost have spurred rapid market growth and have significantly increased the proportion of renewable electricity in the national supply. With regard to meeting renewable portfolio targets, Germany has achieved its ambitious renewable goals ahead of schedule and has set new, higher targets as a result.

- ***Technology-specific tariffs create diversity when set at the appropriate levels.*** Germany's early value-based FIT created incentives for wind but did not accelerate markets for other technologies. The technology-specific tariffs in Germany and Spain, by contrast, caused rapid market acceleration across a portfolio of mature and emerging technologies. The portfolios differed, however, based on the policy priorities in both countries and the manner in which generation cost was defined. In Germany, biogas tariffs have been set high enough to encourage the cultivation of energy crops specifically for anaerobic digestion, whereas in Spain, the pending solar thermal electric development reflects the fact that tariffs have been set at levels sufficient to encourage thermal with storage capacity.
- ***Implementing support for emerging resources is challenging.*** At the EU level, analysis has concluded that support for emerging resources in the short-term could decrease renewable energy policy costs in the long term,38 and many European countries have each created FITs for both near-market and emerging renewable resources. This policy decision can be challenging, however. In the case of PV, for example, Germany and Spain have acknowledged that the high price paid for PV creates additional policy costs, but that these costs are justified because they are blended with the savings created by near-market resources and by the fact that promotion of PV is an industrial (that is, market capture) policy, in addition to an energy

[38] Huber, C., Faber, T., Haas, R., Resch, G., Green, J., Ölz, S., et al. (2004). Green-X: Deriving optimal promotion strategies for increasing the share of RES-E in a dynamic European electricity market. Vienna, Austria: Vienna University of Technology Energy Economics Group; Huber, C., Ryan, L., Ó Gallachóir, B., Resch, G., Polaski, K., & Bazilian, M. D. (2007). Economic modeling of price support mechanisms for renewable energy: Case study on Ireland. Energy Policy, 35(2), 1172-1185

policy.[39] Despite their commitment to PV, both countries have also attempted to address political concerns over policy cost by recently decreasing their PV FITs.[40]

5.3 United States Experience

There has been a sharp increase in interest in FIT design in the U.S. during the past two years, and numerous states have considered FIT policies either in their legislatures or through regulatory proceedings. Several recent studies have provided summaries of these efforts.[41] This Section discusses renewable energy policy trends in the United States and updates previous FIT policy surveys with recent developments.

5.3.1 Trends in Renewable Energy Policy Development

To date, 33 states and the District of Columbia have established renewable portfolio standards (RPS) or voluntary renewable portfolio goals. The early RPS regimes did not target specific technologies, but instead relied on tradable renewable energy credits as their primary compliance mechanism. During the past decade, however, state RPS policies have continued to evolve through the enactment of new RPS policies or amendments of existing standards.[42] Two trends in RPS design have emerged during this period of dynamic policy development that mirror the fundamental design characteristics of European FITs.

The first trend has been in technology differentiation. Under the first generation of RPS policies, different technologies competed to supply renewable energy credits at lowest cost. This competitive environment did not support the development of emerging resources such as photovoltaics. As a result, states such as Arizona, Nevada, and New Jersey created specific

[39] del Río, P., & Gual, M. A. (2007). An integrated assessment of the feed-in tariff system in Spain. *Energy Policy, 35*(2), 994-1012; Nitsch, J., Krewitt, W., Nast, M., Viebahn, P., Gärtner, S., Pehnt, M., et al. (2004). *Environmental policy: Ecologically optimized extension of renewable energy utilization in Germany* (Summary). Berlin, Germany: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

[40] Rutschmann, I. (2008, July). The paralyzed market: Spain's PV industry is concerned about deep subsidy cuts and is upset with its own association. *PHOTON International,* 44-49; Podewils, C. (2008, July). Constant state of revision: The Conservatives are already looking for the next chance to revise the new EEG tariffs. *PHOTON International,* 28-33

[41] Rickerson, W., Bennhold, F., & Bradbury, J. (2008b). FITs and renewable energy in the USA: A policy update. Raleigh, NC, Washington, DC, and Hamburg, Germany: North Carolina Solar Center, Heinrich Böll Foundation North America, and the World Future Council; Tezak, C., & Stanco, K. W. (2008). Renewable FITs American style? Washington, DC: Stanford Group Company.

42 CA, CO, CT, DE, MD, ME, MN, NJ, NM, PA, TX; Ibid.

targets, or carve-outs, for technologies from solar to chicken waste.[43] The carve-out concept spread rapidly and by 2008, there were fourteen states that had specific carve-out provisions.[44] The carve-out concept has also evolved over time to target a broader range of resources. North Carolina, for example, included carve-outs pig waste and chicken waste in addition to solar in its 2007 RPS legislation, and New Mexico amended its RPS to create separate carve-outs for wind, solar, distributed generation, and biomass and geothermal. Carve-outs are an acknowledgement by some states that inter-technology competition did not achieve policy objectives such as resource diversity or technology-specific industry development. The introduction of technology differentiation into RPS regimes seeks to achieve policy goals similar to those targeted by technology-differentiated European FITs.

A second trend has been the introduction of long-term contracts through RPS amendments or supplemental programs. States that have traditionally relied on short-term markets for tradable RECs have begun to introduce long-term contracting in an attempt to decrease REC market volatility and accelerate project development. Connecticut, for example, requires utilities to purchase 150 MW of its RPS resources under long-term contracts, whereas the Rhode Island and Massachusetts legislatures both passed legislation in 2008 designed to encourage long-term REC contracts.[45] New Jersey has also engaged in a lengthy regulatory process to securitize its market for solar RECs.[46]

Given the trends toward long-term contracting and technology differentiation in U.S. state RPS policy making, FITs, which share similar characteristics, are increasingly being proposed as a mechanism for meeting RPS targets. To date, FITs have been proposed at the federal, state, and local levels.

[43] Thurlow, A. R. (2004). *The potential effect of state RPS policies on grid-connected PV capacity*. Proceedings of the American Solar Energy Society 2004 Conference, Portland, OR

[44] See www.dsireusa.org

[45] Rhode Island's legislation was subsequently vetoed by the Governor

[46] Summit Blue Consulting, & Rocky Mountain Institute. (2007). An analysis of potential ratepayer impact of alternatives for transitioning the New Jersey solar market from rebates to market-based incentives (Final Report). Boulder, CO: Summit Blue Consulting. Prepared for the New Jersey Board of Public Utilities, Office of Clean Energy

5.3.2 Federal Level

Congressman Jay Inslee (D-WA) introduced the first federal FIT bill in 2007. The Inslee bill calls for PURPA to be amended to guarantee renewable generators a 20-year incentive payment based on their generation costs, plus a reasonable profit. The proposed federal FIT is similar to the FIT currently in place in Germany, except for the fact that the payments are limited to generators that are 20 megawatts or less.[47] The Inslee Bill has not yet been voted on.

In addition to the proposed federal FIT, the Public Utilities Regulatory Policy Act (PURPA), which many credit as an early version FIT, remains in effect and continues to be used for renewable energy project development in some states, such as Idaho and Oregon.

5.3.3 State Level

During the past two years, there have been numerous legislative, administrative, regulatory, and advocacy initiatives supporting FITs at the state level. Each of these initiatives has been undertaken in states that have renewable portfolio standards.

5.3.3.1 The Michigan Model

In 2007, Michigan Representative Kathleen Law (D) introduced the "Michigan Renewable Energy Sources Act" (HB 5218) in September 2007. The bill would enable generators to receive 20-year, technology-specific payments based on generation cost plus a profit. Wind generators, for example, would be eligible for payments of between \$0.08-\$0.10/kWh, whereas photovoltaics would be eligible for payments of between \$0.48-\$0.71/kWh. Similar bills were also introduced in Illinois, Minnesota, and Rhode Island. The numerous state proposals closely resembled the German FIT legislation, but were generally limited to systems 20 MW and under; to date, none have been enacted.

5.3.3.2 California

California has actively explored FITs in a wide range of contexts during the last several years. Assembly Bill 1969 in 2006 actually established a FIT for renewable energy generators 1.5 MW and smaller. The current California FIT is distinctly different from European FITs in that it

[47] Rickerson, W., Bradbury, J., & Bennhold, F. (2008). *The outlook for FITs in the United States of America.* Proceedings of the 7th World Wind Energy Conference, Kingston, ON

provides a 10-, 15-, or 20-year contract to generators based on a time-differentiated avoided cost value.[48] Generators receive higher remuneration during peak periods, and lower payments during off-peak periods.[49]

The California Public Utilities Commission (CPUC) is currently considering whether to expand the FIT project cap from 1.5 MW to 20 MW.[50] In a parallel and separate initiative, the California Energy Commission (CEC) is considering a technology-differentiated FIT based on generation costs plus a reasonable profit for projects 20 MW and under.[51] The CEC's 2007 *Integrated Energy Policy Report* recommended an exploration of FITs for projects over 20 MW. During the regulatory proceedings, however, stakeholders expressed a preference for limiting FITs to projects below 20 megawatts.[52] The reasons for this varied: some stakeholders preferred a near-term focus on smaller generators in order to gain more experience prior to a wider application; some wanted to limit policy cost and market growth given state transmission constraints; others believed that the feed-in tariff would fill a policy gap for generators under 20 MW, but that generators over 20 MW could effectively compete in the standard RPS solicitation process.[53] It remains to be seen how the CEC and CPUC proceedings will be reconciled.

5.3.3.3 Gubernatorial Initiatives

In addition to the regulatory and legislative initiatives that have recently been considered in the U.S., several U.S. Governors have either proposed FITs or have convened formal task forces

[48] Rickerson, W., Baker, S. E., & Wheeler, M. (2008). Is California the next Germany? Renewable gas and California's new FIT. *BioCycle, 49*(3), 56-61.

[49] The original AB 1969 bill was available only to renewables sited on water and wastewater treatment plant facility property, but was extended to all customers under CPUC Order No. 07-07-027. Senate Bill 380 in 2008. SB 380 subsequently expanded the statewide cap on the FIT from 250 MW to 500 MW.

[50] California Public Utilities Commission. Amended Scoping Memo and Ruling of Assigned Commissioner Regarding Phase 2 of Tariff and Standard Contract Implementation for RPS Generators. June 5, 2008. http://docs.cpuc.ca.gov/efile/RULC/83784.pdf.

[51] Grace, R., Rickerson, W., Corfee, K., & Porter, K. (2008). *California FIT design and policy options* (Second Draft Consultant Report, CEC-300-2008-009D2). Sacramento, CA: California Energy Commission

[52] California Energy Commission. (2007). *2007 Integrated Energy Policy Report* (CEC-100-2007-008-CMF). Sacramento, CA

[53] Grace, R., Rickerson, W., Corfee, K., & Porter, K. (2008). *California feed-in tariff design and policy options* (CEC-300-2008-009-2D, Second Draft Consultant Report). Sacramento, CA: California Energy Commission, *see* Appendix B.

that have recommended FITs. In Wisconsin, the Governor's Task Force on Global Warming recently recommended FITs for distributed generators smaller than 15 MW.[54] In Oregon, Governor Ted Kulongoski proposed a FIT as part of his legislative agenda for climate change in 2009.[55] Finally, the Virginia Governor's Commission on Climate Change Electricity Generation/Other Stationary Source Workgroup recently recommended a feasibility study of a FIT be conducted by the State Corporation Commission.[56]

5.3.3.4 Municipal Level

5.3.3.4.1 Gainsville, Florida

The Gainsville Regional Utility (GRU) became the first municipal utility in the U.S. to propose a FIT in 2008. The GRU's FIT would be available only to PV generators, and would be set at $0.26/kWh for 20 years. Generators would take the FIT in lieu of, rather than in addition to, rebate payments and net metering.[57] The Gainsville City Commission is currently considering the FIT.

5.3.3.4.2 Los Angeles, California

On November 24, 2008, Mayor Antonio Villaraigosa of Los Angeles announced that the Los Angeles Department of Water and Power would implement a FIT for 150 MW of photovoltaics by 2016.

The development of solar FITs in the U.S., if successful, would mirror the development of solar FITs in Europe. In 1993, the City of Aachen created the first photovoltaic FIT. The model

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[54] Governor's Task Force on Global Warming. (2008). *Wisconsin's strategy for reducing global warming*. Madison, WI: Wisconsin Department of Natural Resources. Final Report to Governor Jim Doyle.

[55] Kulongoski, T. R. (2008). *Answering the Oregon challenge: Climate change*. Salem, OR: Office of the Governor.

[56] Virginia Governor's Commission on Climate Change. Electricity Generation/Other Stationary Source Workgroup Revised Draft Recommendations 10/16/08. Richmond, VA.

[57] Gainsville Regional Utilities. Proposal to replace non-residential solar photovoltaic rebate and net metering financial incentives with a solar FIT (Draft). Gainsville, FL,

diffused to 60 other cities in Europe, and ultimately became a model for the solar provisions in Germany's 2000 FIT laws.[58]

5.3.4 Conclusions for the U.S.

Hawaii's plan to establish a FIT by July, 2009, places the State at the leading edge of renewable energy policy development in the United States. Although there are distinct differences between renewable energy policy considerations in Hawaii and on the mainland, overall U.S. policy efforts to date can provide useful lessons against which Hawaii can benchmark its own efforts as it moves forward.

- ***FITs can be used to meet RPS targets***. Some commentators paint RPS and FITs as mutually exclusive, but there is no inherent conflict between the two policies and FITs can be used to achieve RPS targets. In Europe, each of the countries that have FITs also have renewable energy percentage targets that they are mandated to meet by a certain date. In the U.S., more relevantly, each of the state FITs has been made in states that already have RPS requirements.
- ***U.S. FIT proposals target distributed resources.*** Although in Europe, FITs are typically not limited to a specific project size, most U.S. state proposals limit FIT project size to below 20 MW or smaller. These limitations have been proposed in order to limit project costs while recognizing the fact that FITs can be used as a mechanism to control policy costs and/or impacts, and target resources that "fall through the cracks" of RPS mechanisms that favor larger projects.
-
- ***U.S. state FIT proposals tend to be cost-based.*** The current FIT in California is based on avoided cost, but the majority of proposed U.S. FIT policies – including that proposed by the California Energy Commission – either propose differentiated payment levels based on generation cost, or state an intent to develop rates that are based on generation cost.

[58] Solarenergie-Förderverein. (1994). *A new path to self-sustaining markets for PV.* Proceedings of the 24th IEEE Photovoltaic Specialists Conference, Waikoloa, Hawaii

6. Appendix C: European FIT Practices

This Appendix provides the following summaries on European practices with respect to FIT program development:

- Technology categories under European FIT programs
- Caps under European FIT programs
- Procedures and methodologies to set FIT rates in Europe.

6.1 Technology categories

The following Section summarizes the different technology categories that qualify for FITs in the Netherlands, Germany and Spain.

The cost of generation of the different renewable energy sources varies significantly by technology. FITs have been developed to encourage the use of renewable technologies and address the variations in cost between them. Specifically, FITs can account for multiple variables including technology being deployed, fuel, and, in some cases, project size. The categories differ by country and over time. When introducing new categories, a balance must be struck between economical effectiveness (many categories) and simplicity (few categories).

Differentiating the FIT rates by technology category and project size adds flexibility to the system. For example, over the years in the Netherlands, new categories have been introduced to distinguish between installations with bio-oil as fuel and those with solid biomass as fuel. Similarly, the categories differentiate between small-scale installations and large, independently operating installations. In Germany, the number of different tariff categories has increased over the years to more than 60.

Tables 6-1 through 6-3 provide detailed information on the different renewable energy technologies that are currently eligible for FITs in the Netherlands, Germany, and Spain, respectively.

Table 6-1
Categories and Tariff Setting in the Netherlands

Tabel A. 1 *Tariefstelling feed-in-premie 2008 per categorie (NL)*

	Categorie	Tarief[22] [ct/kWh]
Wind op land		3,6[23]
Wind op zee		n.v.t.[24]
Waterkracht		n.v.t.
Golfenergie		n.v.t.
Getijdenenergie		n.v.t.
Geothermie		n.v.t.
Vaste biomassa	<50 MW	6,2
Overige biomassa (waaronder vloeibaar)		n.v.t.
GFT-vergisting, mestcovergisting	<50 MW	6,2
Bij- en meestook van biomassa		n.v.t.
Stortgas, AWZI, RWZI		0,0[25]
Zon-PV	0,6 kW-3,5 kW	33,0
AVI		-0,6 tot 1,6[26]

Table 6-2
Categories and Tariff Setting in Germany

Tabel A.1 *Tariefstelling vast tarief 2008 per categorie (DE)*

Hernieuwbare technologie	Categorie[27]	Feed-in-tarief [€ct/kWh]				Degressie [%]
ZonPV		Geïnstalleerd op gebouwen	Geïntegreerd op de façades van gebouwen	Overig		5% (6.5% voor 'Overig')
	< 30 kW	46,75	51,75	35,49		
	30 kW-100 kW	44,48	49,48			
	> 100 kW	43,99	48,99			
Biomassa		Algemeen	Hernieuwbare bronnen	WKK	Gebruikt hout	1,5%
	< 150 kW	10,83	16,83	12,83	3,66	
	150-500 kW	9,32	15,32	11,32		
	500 kW-5 MW	8,38	12,38 (10,88 voor hout)	10,38		
	5 MW-20 MW	7,91	7,91	9,91		
Waterkracht						
Grootschalig	< 500 kW		7,36			1%
	500 kW-10 MW		6,38			
	10 MW-20 MW		5,86			
	20 MW-50 MW		4,38			
	50 MW-150 MW		3,54			
Kleinschalig	< 500 kW		9,67			-
	< 5 MW		6,65			
Geothermisch	< 5MW		15,00			1%, vanaf 2010
	5 MW-10 MW		14,00			
	10 MW-20 MW		8,95			
	> 20 MW		7,16			
Wind						
Offshore			Geïnstalleerd voor 31-12-2010, eerste 12 jaar	Geïnstalleerd na 31-12-2010 en na 12 jaar		2%, vanaf 2008
			8,92	6,07		
Onshore			Voor tenminste 5 jaar na installatie	Na enige tijd, afhankelijk van de opbrengst		2%
			8,03	5,07		
Stort-, riool- en mijngas				Bij gebruik van specifieke innovatieve technologieën		1,5%
	< 500 kW		7,22	9,22		
	500 kW-5 MW (mijngas>5MW)		6,25	8,25		
	> 5 MW		Marktprijs wordt betaald voor de capaciteit boven 5 MW			

Bron: (BMU: http://www.erneuerbare-energien.de/files/pdfs/allgemein/application/pdf/ verguetungssaetze_nach_eeg.pdf).

[27] Anders dan in Nederland, kan een installatie in Duitsland subsidie krijgen uit meerdere categorieën. Zo krijgt een kleinschalige waterkrachtinstallatie van 1 MW, voor de helft (0-500 kW) 9,67 ct/kWh subsidie, en voor de andere helft (500 kW-1 MW) 6,65 ct/kWh.

Table 6-3
Categories and Tariff Setting in Spain

Tabel A.2 *Tariefstelling 2008 per categorie vast tarief en premie (ES)*

Technologie categorie		Vermogen [MW]	Periode 1 [jr]	Periode 2 [jr]	Vast tarief periode 1 [ct/kWh]	Vast tarief periode 2 [ct/kWh]	Referentiepremie periode 1 [ct/kWh]	Referentiepremie periode 2 [ct/kWh]	Bovengrens [ct/kWh]	Ondergrens [ct/kWh]
b.1: Zon	b.1.1: Fotovoltaïsch	≤ 0,1	1-25	> 25	44,0	35,2				
		0,1 - 10	1-25	> 25	41,8	33,4				
		10 - 50	1-25	> 25	23,0	18,4				
	b.1.2: Zonthermisch		1-25	> 25	26,9	21,5	25,4	20,3	34,4	25,4
b.2: Wind	b.2.1: Wind op land		1-20	> 20	7,3	6,1	2,9	0,0	8,5	7,1
b.3: Geothermisch / oceaan			1-20	> 20	6,9	6,5	3,8	3,1		
b.4: Hydro (kleinschalig)		< 10	1-25	> 25	7,8	7,0	2,5	1,3	8,5	6,5
b.5: Hydro (grootschalig)		10 - 50	1-25	> 25	*	**	2,1	1,3	8,0	6,1
b.6: Biomassa	b.6.1: Energiegewassen	≤ 2	1-15	> 15	15,9	11,8	11,5	0,0	16,6	15,4
		> 2	1-15	> 15	14,7	12,3	10,1	0,0	15,1	14,3
	b.6.2: Agro residuen	≤ 2	1-15	> 15	12,6	8,5	8,2	0,0	13,3	12,1
		> 2	1-15	> 15	10,8	8,1	6,2	0,0	11,2	10,4
	b.6.3: Residuen uit	≤ 2	1-15	> 15	12,6	8,5	8,2	0,0	13,3	12,1
	bosbouw	> 2	1-15	> 15	11,8	8,1	7,3	0,0	12,3	11,4
b.7: Biomassa	b.7.1: Stortgas		1-15	> 15	8,0	6,5	3,8	0,0	9,0	7,4
	b.7.2: Vergistingsgas	≤ 0,5	1-15	> 15	13,1	6,5	9,8	0,0	15,3	12,4
		> 0,5	1-15	> 15	9,7	6,5	5,8	0,0	11,0	9,6
	b.7.3: Mestverbranding vloeibare biobrandstoffen		1-15	> 15	5,4	5,4	3,1	0,0	8,3	5,1
b.8: Biomassa uit industriële processen	b.8.1: Agro residuen	≤ 2	1-15	> 15	12,6	8,5	8,2	0,0	13,3	12,1
		> 2	1-15	> 15	10,8	8,1	6,2	0,0	11,2	10,4
	b.8.2: Residuen uit	≤ 2	1-15	> 15	9,3	6,5	4,9	0,0	10,0	8,8
	bosbouw	> 2	1-15	> 15	6,5	6,5	1,9	0,0	6,9	6,1
	b.8.3: Black liquor	≤ 2	1-15	> 15	9,3	6,5	5,2	0,0	10,0	8,8
		> 2	1-15	> 15	8,0	6,5	3,2	0,0	9,0	7,5

Bron: Koninklijk besluit 661/2007/Held *et al.*, 2007.

6.2 FIT Budget Caps

Feed-in-tariffs have generally been open-ended with the total subsidy not limited by law or regulation in Europe. However, in recent years, we've seen a trend to establish budget limits or caps on the total subsidies under the FIT systems as a means to avoid budget overruns.

In the Netherlands, tariffs had to be adjusted twice to prevent budget overruns. In May 2005 the tariffs for wind projects on sea and biomass co-firing were set to zero. Similarly, in August 2006 other renewable generation technology categories were set to zero. Also in 2006, the Dutch electricity law was revised to give the Minister of Economic Affairs authority to set a maximum budget for each category or for all categories combined. This situation is not unique to the Netherlands. In Spain and Germany, there is increasing support and political willingness to increase control over feed-in-tariff budgets. Spanish law permits tariff review if previously established capacity goals are reached. The goals are set in advance and are related to the maximum supplied power (Bustos, 2004).

The following section examines Dutch budget caps in more detail.

6.2.1 Budget Caps in the Netherlands

With limited FIT budgets in the Netherlands, it's possible that not all subsidy requests can be honored. Thus, the law provides two ways of distributing subsidies for each category:

- By setting a production ceiling by category or on the overall FIT-budget
- By a tender process in which requests for subsidy are ranked.

6.2.1.1 Production Ceilings

In the Netherlands, production ceilings place a limit on generation as a mechanism to gain greater fiscal control. For the most part, the introduction of a production ceiling does not change the basic working principle of a FIT system. However, it does introduce caps or limits on production or budget expenditures under the FIT system.

With the standard FIT premium, the Dutch government decides in advance on the maximum budget and the amount of electricity production per category. Using supply curves, production can be projected for the different technology categories. By establishing a ceiling on the production volumes by technology, a maximum budget is set for each FIT category and for the complete FIT system. These caps effectively restrict production volume to minimize any adverse budget effects caused by the FIT system.

The effectiveness of this approach in maintaining budget limits is highly dependent on how accurate the production volume can be estimated for the different FIT categories. For highly developed and homogeneous technologies, accuracy is typically quite high. For heterogeneous technology categories that contain high development risk, the accuracy level can be quite low.

A downside risk of production ceilings is that they can drive production cost up over time. Long-term prices are likely to increase as a result of rejected projects and additional project monitoring.

6.2.1.2 Tendering

A tender process in the Netherlands is roughly analogous to a competitive solicitation process in the United States. A tendering procedure permits screening for certain types of projects and project sizes. It can lead to more potential suppliers and lower price if it employs an effective competitive market mechanism. However, price fixing has been known to be an issue in markets with only a limited number of competitors.

A limitation of the tendering process is the lengthy process of developing initiatives, evaluating responses, and making decisions. In addition, the transaction costs for both buyers and sellers are significant, especially the first time. Overall, preparing a tender is a time-consuming matter. In theory, a tender can be cost effective, and market over stimulation is generally lower than when using feed-in premiums (van Tilburg et al, 2006).

For the reasons stated above, tenders are generally best suited for large-scale projects that have a high uncertainly of the total cost and tenders are less suited for smaller or more homogeneous projects.

6.3 Tariff setting methodology

Europe has two types of feed-in systems, the FIT and the feed-in premium. Germany has a FIT system, while the Netherlands has a feed-in premium system. In Spain, the generator can choose between either of these two options on an annual basis.

With feed-in support tariff systems, renewable electricity is not sold on the electricity market, but rather compensation is paid directly to the generator for the electricity produced. Electricity operators are obliged to accept renewable generation on the grid and to pay the pre-determined

FIT rates of compensation. In contrast, electricity from renewable generation that is supported by the feed-in premium is sold on the electricity market.

Although the similarities are plentiful, each country has had to adjust its policies supporting renewable electric generation. No one renewable energy policy has proved to be both flexible and stable enough to also be effective and efficient. This Section provides an overview of these feed-in systems' similarities and insights into how these approaches address tariff setting, calculation of electricity generation costs, and the stakeholder process.

6.3.1 European tariff setting

The following table provides an overview of the different FIT systems in the Netherlands, Germany, and Spain.

Table 6-4
Properties of FIT Systems in Europe

	Netherlands	Germany	Spain-FIP	Spain-FIT
FIT (FIT) or premium FIP	FIT	FIT	FIP	FIT
Categories for technology/fuel combination	Yes	Yes	Yes	Yes
Categories for size of installation	Yes	Yes	Yes	Yes
Stepped tariffs	Yes	Yes	Yes	Yes
location specific tariff for wind	Yes	Yes	No	No
Duration of subsidy (years)	12-15	20[59]	lifespan of installation	lifespan of installation
frequency of renewal of tariffs (years)	1	4	1	4
delay in renewal of tariffs (years)	2	-	2	2
Budget maximum	Yes	No	No	No
Digressional tariffs	No	Yes	No	No
additional stimulation within FIT/FIP	Yes	No	Yes	Yes
category for co-firing biomass	Yes	No	Yes	Yes
category for waste incineration installations	Yes	No	Yes	Yes

Feed-in premiums or tariffs are based on the quantity of electricity supplied to the grid. In the different European cases, the support level is coupled with production volume, expressed in

[59] For some categories, also 15 or 30 years

kilowatt-hours. Production costs are used to calculate compensation. Other costs outside the sphere of influence of the producer, such as societal costs, can be included.[60]

6.3.2 Timing

One advantage of feed-in subsidies is that they offer long-term certainty for investors. There is always a delay between making the investment decision and producing electricity. For entrepreneurs, it is desirable to have predictability and certainty on the tariff level as this provides a solid foundation for investment decisions.

In both the Netherlands and Spain, the premium tariffs are set annually for the next two years. The fixed tariffs in Spain and Germany are reviewed once every four years.

In Germany, the FIT rates became effective immediately after publication of the 2004 revision and the 2008 revision will become effective on January 1, 2009.

In Spain, the tariff can also be revised midterm for some categories if the predetermined goals for capacity are met. The new tariffs and premiums in Spain become effective by January 1 of the second year after revision. Investors have substantial certainty that the tariffs and premiums are fixed at least a year in advance.

6.3.3 Tariff Setting

In European countries with a FIT system, the responsible ministry typically seeks the advice of a research institution to help determine the tariff level. The ministry is responsible for setting the support level, which can be accepted or rejected by parliament. The involvement of external stakeholders differs from country to country.

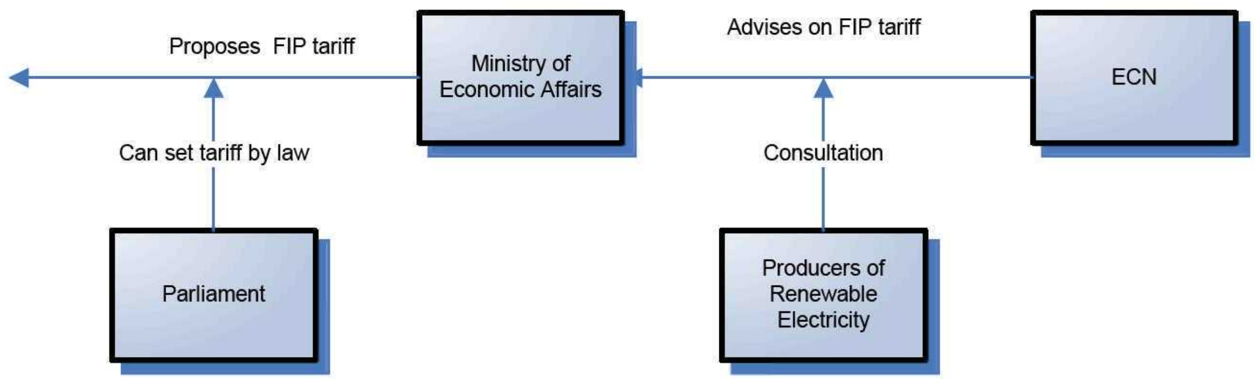
6.3.3.1 Tariff Setting in the Netherlands

In the Netherlands as shown in Figure 7-1, ECN and KEMA jointly publish a draft advice notice to the Ministry of Economic Affairs on the cost levels for production, which serves as the basis of the subsidy tariffs set by the ministry.[61]

[60] see website http:// http://www.externe.info/ for more information on cost of externalities

The draft advice notice addresses techno-economic parameters that determine the production costs for many categories. The draft advice is a public document, and selected stakeholders are asked for comments. On the basis of the findings, ECN and KEMA issued a final recommendation concerning the cost of generation levels for each category. Proposed tariff modifications are then forwarded to the Ministry of Economic Affairs.

Figure 6-1
Tariff Setting in the Netherlands



A more detailed analysis of tariff setting in the Netherlands is provided in Section 7.3.4.

6.3.3.2 Tariff Setting in Germany

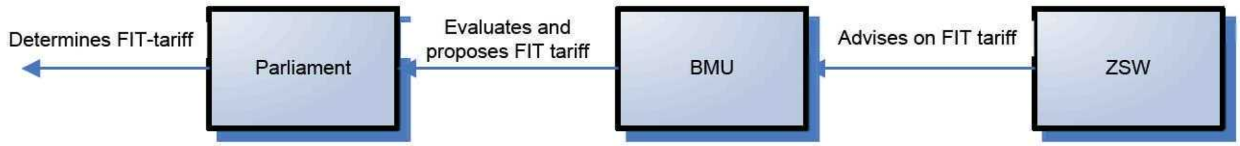
In Germany, the Ministry of Environment (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, BMU) is required to draft an evaluation report every four years. This report is written by a project group, headed by the ZSW (Zentrum für Sonnenenergieund Wasserstoff-Forschung) as shown in Figure 7-2. The report assesses costs for new projects in several categories. Producers are obliged to provide relevant information to help determine the costs. Stakeholders are passively involved in setting tariffs through the commenting process.

The last FIT evaluation report was drafted at the end of 2007 in Germany (Staiß, 2007). Once the evaluation report was filed, the parliament could then decide whether to modify the tariffs. Just as in the Netherlands, stakeholder organizations in Germany can share their views with the

[61] ECN is the Energy Research Center of the Netherlands.

parliament. The German parliament decided in June 2008 to pass the proposal with several amendments.

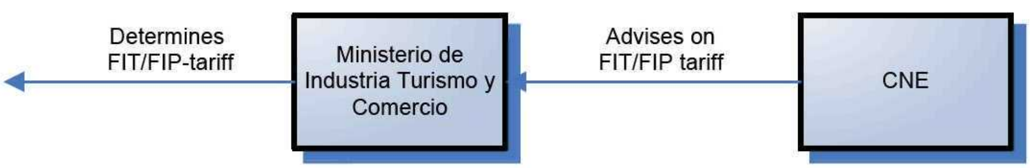
Figure 6-2
Tariff Setting in Germany



6.3.3.3 Tariff Setting in Spain

In Spain, tariff setting is performed by the Ministerio de Industria Turismo y Comercio and relies heavily on the research of the Comisión Nacional the Energía (CNE) as shown in Figure 7-3. Tariffs are not passed through parliament for approval but become effective after a so-called `Royal decision'. CNE recommends modifications to the feed-in system, including the tariffs. CNE's uses input from a Commission that includes representatives of the most important stakeholders. Through participation in the Commission, stakeholders are indirectly involved in the FIT tariff decision-making process.

Figure 6-3
Tariff Setting in Spain



6.3.4 Tariff Setting in the Netherlands in Detail

The process of setting renewable energy tariffs is difficult. Tariffs set at the right level are needed to make a feed-in premium or tariff both efficient and effective. If the tariffs are set too low, the deployment rate of renewables will remain too low, but if the tariffs are set too high, society will pay a high price for renewable development and energy developers will receive excess payments.

In the Netherlands (but also in other countries), the investigation of the generation or production costs of renewable energy is made by an independent consultant. It is difficult for authorities to undertake this investigation as they are a stakeholder in the process and therefore will not be trusted by the other market stakeholders. An independent consultant is then assigned the task of estimating the cost of renewable generation, which is representative for the actual market conditions and is not influenced by political agendas or stakeholder interests.

Table 6-5 displays the range of documentation that supports FIT development in the Netherlands.

Table 6-5
List of Production Cost Tables and Fact Sheets for Financial Analysis

SDE - Fact sheet 00 Fuel prices concept.doc

SDE - Fact sheet 01 Wind Onshore concept.doc
SDE - Fact sheet 02 Wind Offshore concept.doc
SDE - Fact sheet 03 Biomass cofiring Gas-Oil concept.doc
SDE - Fact sheet 04 Biomass cofiring Coal-Woodpellets concept.doc
SDE - Fact sheet 05 Biomass cofiring Coal-AgroRes concept.doc
SDE - Fact sheet 06 Biomass Standalone oil concept.doc
SDE - Fact sheet 07 Biomass Standalone Wood concept.doc
SDE - Fact sheet 08 Anaerobic Digestion concept.doc
SDE - Fact sheet 09 Waste Incineration concept.doc
SDE - Fact sheet 10 SolarPV concept.doc [draft]

SDE - Fact tabel 01 Wind Onshore concept.doc
SDE - Fact tabel 02 Wind Offshore concept.doc
SDE - Fact tabel 03 Biomass cofiring Gas-Oil concept.doc
SDE - Fact tabel 04 Biomass cofiring Wood-Coal concept.doc
SDE - Fact tabel 05 Biomass cofiring AgroRes-Coal concept.doc
SDE - Fact tabel 06 Biomass Standalone oil concept.doc
SDE - Fact tabel 07 Biomass Standalone wood concept.doc
SDE - Fact tabel 08 Anaerobic Digestion concept.doc
SDE - Fact tabel 09 Waste Incineration concept.doc
SDE - Fact tabel 10 Solar PV concept.doc

OT2008 Wind Offshore (UK).xls

The table indicates that the process for setting the FIT rates is quite lengthy and data intensive. As displayed, there are a large number of fact sheets and tables that provide the backup data on the cost of generation. For each technology, a key objective is to determine the 'financial gap'. The financial gap is calculated using a cash-flow analysis of a project taking into account a large set of factors that determine the financial performance of projects in a certain category.

Using a net-present value approach, with a fixed required return on equity, the required revenues from electricity are calculated. The financial gap is the difference between the required electricity price for a profitable project and the assumed cost of generation. For each category, the financial gap is calculated and a sensitivity analysis is performed. Finally, results are combined and summarized in a draft document that is submitted to the Ministry. This draft advice document is in the public domain and a consultation process with stakeholders takes place. Eventually, the final version of the advice document is used by the Ministry to propose the tariff to parliament. In Table 6-6, a sample fact sheet for the Onshore Wind category has been translated from Dutch to English.

The process of setting renewable energy tariffs is inherently difficult. The quality and reliability of the cost data gathered is crucial. Questions that improve the reliability and the future application of the data gathered include:

- What is included in the parameter value and what is not?
- Is the value specific for this category?
- Is the value fixed or policy determined?
- Does the value follow from the choice of related variables?
- How certain is the parameter value; is there a range?
- How sensitive is the outcome to variations in this parameter?
- Is the value expected to change much over time?
- Is the value expected to be topic of dispute?

Table 6-6
On-shore Wind[62]

Wind onshore

INPUTPARAMETERS	Value	Unit	Comment
Unit size	3000	kWe	
Unit size (electrical)	3000	kWe	
Operational time/ Full load hours	2000	Hours/Year	
Economic life	15	Year	
Electrical efficiency	0%		
Thermo efficiency CHP	0%		
Reference efficicency CHP	0%		
Saving fuel tax (BSB) for CHP	0.0000	Euro/m3	
Investment costs	1100	Euro/kWe	
Maintenance costs fixed	39	Euro/kWe	
Maintenance costs variable	0	Euro/kWhe	
Miscellaneuos operational costs	0	Euro/kWhe	
Energy content secondary fuel	0	GJ/ton	
Costs secondary fuel	0	Euro/tonne	
Fuel costs substituted fuel	0.00	Euro/tonne or Euro/m3	
Effectiveness fuel substitution	0%		
energy content substituted fuel	0	GJ/ton or GJ/m3	
Market price elektricity	0	Euro/kWh	
Balancing costs	0.006	Euro/kWh	
EIA applies?	ja		Choose 'yes' of 'no'
EIA	44%		Maximum that legally applies for EIA
EIA max	47,520,000	Euro	Maximum that legally applies for EIA
Part of the investment that applies for EIA	85%		
Return on debt	5%		
Required return on equity	15%		
Equity share incl. EIA effect	20%		
Debt share incl. EIA effect	80%		
Corporate (income) tax	26%		
Loan duration	15	Year	
Depreciation period	15	Year	
Policy period	15	Year	Period during which subsidies are paid

OUTPUT	Value	Unit
Financial Gap	8.4	Eurocent/kWh

6.3.4.1 Calculation of Electricity Generation Costs

When calculating generation costs, a distinction must be made between already installed capacity and new plants. For existing plants, only the running costs (short-term marginal costs)

[62] Example of a filled-in factsheet for the Dutch FIT (SDE) tariff setting for the category wind onshore (example sheet 'OT2008 Wind Offshore (UK), SDE, 2008). The EIA is a tax exemption measure for investments in energy-saving equipment and sustainable energy. This tax relief program gives a direct financial advantage to Dutch companies that invest in energy-saving equipment and sustainable energy. Forty-four percent of the annual investment costs of such equipment (purchase costs and production costs) are deductible from the fiscal profit over the calendar year in which the equipment was procured, subject to a maximum of EUR 111 million.

are relevant for the economic decision as to whether the plant should be used for electricity generation or not, while, for new capacities, the long-term marginal costs are important.

6.3.4.1.1 Existing Plants

The annual running costs are made up of two parts: fuel costs and operation and maintenance (O&M) costs. The fuel costs are a function of the fuel price of the primary energy carrier and its efficiency. Hence, the O&M costs, referring to the energy unit in the database, must be coupled with the full-load hours.[63] In general, one average operation time (full-load hour) is taken for each technology band. Analytically, the generation costs for existing plants are given by:

$$C = C_{VARIABLE} = C_{FUEL} + \widetilde{C}_{O\&M} = \frac{p_{FUEL}}{\eta_{el}} + \frac{C_{O\&M}}{H} * 1000$$

Where:

C	Generation costs per kWh [€/MWh]
$C_{VARIABLE}$	Running costs per energy unit [€/MWh]
C_{FUEL}	Fuel costs per energy unit [€/MWh]
$\widetilde{C}_{O\&M}$	Operation and maintenance costs per energy unit [€/MWh]
$C_{O\&M}$	Operation and maintenance costs per energy unit [€/(kW*a)]
p_{FUEL}	Fuel price primary energy carrier [€/$MWh_{primary}$]
h_{el}	Efficiency electricity
H	Full-load hours [h/a]

Apart from all kinds of biomass (e.g., biogas, solid biomass, sewage, and landfill gas), renewables have zero fuel costs, so running costs are determined by O&M costs only. Therefore, the running costs for renewable generation projects are normally low compared to fossil fuels.

6.3.4.1.2 *Combined Heat and Power*

In the case of simultaneous electricity and heat generation, electricity generation costs are calculated by considering the revenues gained from the purchase of the heat.

[63] The full-load hours represent the equivalent time of full operation in a year. It is calculated for a certain power plant by dividing the amount of electricity generated per year by its nominal power capacity. For the theoretical static cost curves, this term reflects an important aspect, namely the suitability of sites (e.g. for wind energy).

$$C = C_{VARIABLE} = C_{FUEL} + \widetilde{C}_{O\&M} - R_{HEAT} = \frac{p_{FUEL}}{\eta_{el}} + \frac{C_{O\&M}}{H} * 1000 - p_{HEAT} \frac{\eta_{heat}}{\eta_{el}} \cdot \frac{H_{heat}}{H_{el}}$$

Where:

C	Generation costs per kWh [€/MWh]
$C_{VARIABLE}$	Running costs per energy unit [€/MWh]
C_{FUEL}	Fuel costs per energy unit [€/MWh]
$\widetilde{C}_{O\&M}$	Operation and maintenance costs per energy unit [€/MWh]
$C_{O\&M}$	Operation and maintenance costs per energy unit [€/(kW*a)]
R_{HEAT}	Revenues gained from purchase of heat [€/MWh]
p_{FUEL}	Fuel price primary energy carrier [€/$MWh_{primary}$]
p_{HEAT}	Heat price [€/MWh_{heat}]
h_{el}	Efficiency electricity generation
h_{heat}	Efficiency heat generation
H	Full-load hours [h/a]

6.3.4.1.3 New Plants

The calculation of the generation costs of electricity for new plants consists of two parts, variable costs and fixed costs. In more detail, the generation costs are given by:

$$C = C_{VARIABLE} + \frac{C_{FIX}}{q_{el}} = \left(C_{FUEL} + \frac{C_{O\&M}}{H} * 1000 \right) + \frac{1000 * I * CRF}{H}$$

Where:

C	Generation costs per kWh [€/MWh]
q_{el}	Quantity of electricity generation [MWh/a]
$C_{VARIABLE}$	Running costs per energy unit [€/MWh]
C_{FIX}	Fixed costs [€]
C_{FIX} / q_{el}	Fixed costs per energy unit [€/MWh]
C_{FUEL}	Fuel costs per energy unit [€/MWh]
$C_{O\&M}$	Operation and maintenance costs per energy unit [€/(kW*a)]
I	Investment costs per kW [€/kW]
CRF	Capital recovery factor:

$$CRF = \frac{z * (1+z)^{PT}}{\left[(1+z)^{PT} - 1\right]}$$

Z	Interest rate [1]
P	Payback time of the plant [a]
H	Full-load hours [h/a]

Fixed costs occur independently whether the plant generates electricity or not. These costs are determined by investment costs (I) and the capital recovery factor (CRF).

6.3.4.1.4 Investment Costs

The investment costs differ by technology and energy source. In general, investment costs per unit capacity for renewable generation are higher than for conventional technologies based on fossil fuels. Understandably, differences also occur between renewable energy technologies. For example, investment costs per unit capacity for small hydropower plants are generally more than double those for wind turbines. As most renewable energy technologies (with the exception of large scale hydro-power) are still not mature, investment costs are expected to decrease over time.

6.3.4.2 Stakeholder Interaction

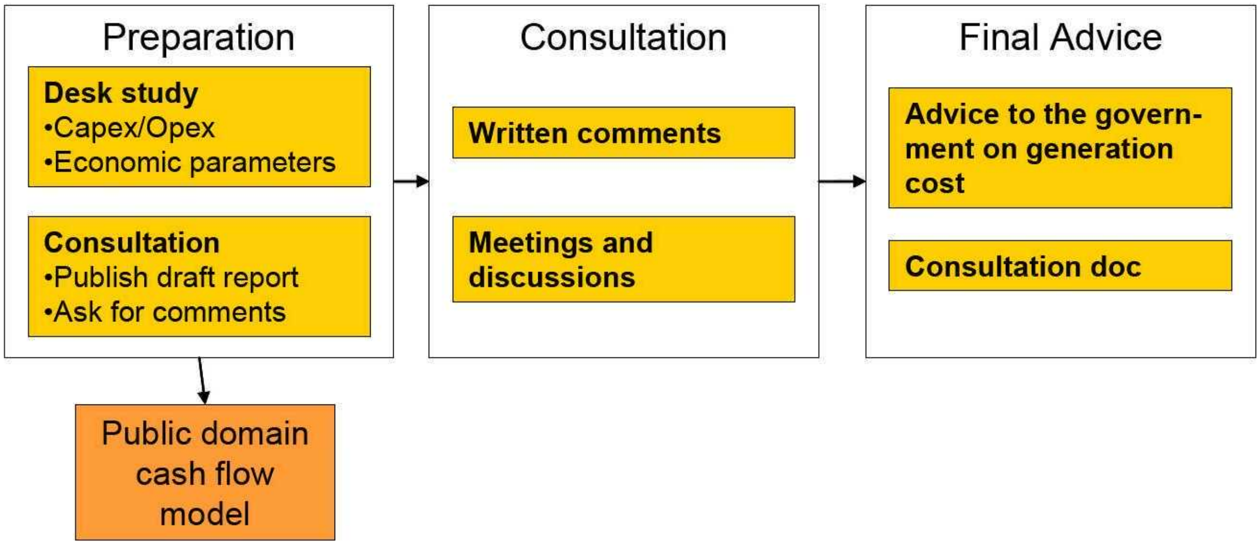
In the Netherlands, stakeholders and market participants are involved in the tariff setting process. The decision to incorporate stakeholder input is based on the premise that it is almost impossible for the government to know the costs of generation (investment costs, O&M costs, etc). This information is only available to the market players because they are involved in actual transactions (buying and selling equipment, power purchase agreements, fuel contracts, etc). Only by getting access to these data is it possible to determine a suitable generation cost level.

The stakeholder process contains a number of vulnerabilities:

- Stakeholders have a vested interest in providing information that is “biased” towards influencing the final tariff level in a positive manner
- The government only sees the result of the renewable energy support, but has no real access to market data
- The consultant has to guard its status as an independent institute and not lean toward one of the parties, otherwise its credibility will be lost
- The process has a direct and substantial impact on policy and budget.

The Figure 6-4 depicts an approach that has been quite successful since its adoption in 2003.

Figure 6-4
Stakeholder Process in the Netherlands



During the preparation phase, the consultant undertakes a desktop study. In this phase, as much information as possible is collected based on publicly available data, market surveys, and international references. This information is compiled in a draft report, which gives an overview of the assumptions and the derived cost of renewable electricity. The cost calculation is performed using a public domain cash flow model, which is available to all the stakeholders, enabling them to check the calculations.

In the consultation phase, reactions on the report are actively sought. Stakeholders are asked to comment and send information. This information should be based on actual data such as contracts, quotations, fuel price references, etc. If needed, more information can be exchanged in meetings or workshops.

Finally, based on the draft report and information collected during consultation, an advice notice is formulated, which is then sent to the government. In response to stakeholder feedback, a consultation-response document is prepared, which systematically addresses how each identified concern was considered.

During interaction with stakeholders, the consultant should be conscious about confidentiality and sensitivity of the data given and about the interests and roles of the actors. This is important as in most cases it is not a one time operation, but returns on a regular (annual) basis.

The following table provides an overview of stakeholders involved in the process, their objectives and, in general, the resulting behavior.

Table 6-7
Overview of Stakeholders involved in FIT Process in the Netherlands

Stakeholder	Objective	Behavior
Government	Meet renewable targets Limited budget risk Low cost for consumer Sustainable generation	Low tariffs Fixed budgets Sufficient generation
Project developer	High profits Controllable risks Bankable projects	Increase costs Lower costs
Banks	Secure projects High interest rates	Stable support High stable cashflow
Manufacturers	Stable investment climate High revenue	Increase prices Fixed O&M contracts

Key conclusions regarding stakeholder interaction include the following observations:

- It is difficult for the government to know exact cost of renewable energy resources
- Market parties have the knowledge, but there is a drive to increase costs
- A process of consultation may help to derive costs close to market conditions
- Consultation process increases acceptability for stakeholders
- Consultation allows government to be more confident about the generation costs.

6.4 Interconnection Policies in Europe under FIT Programs

According to the *Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources,* the EU Member States have to ensure that transmission and distribution system operators guarantee grid access for electricity generated by renewable energy sources.[64] Grid operators are required to publish their standard rules on sharing the costs for

[64] Evaluation of different feed-in tariff design options – Best practice paper for the International Feed-In Cooperation, October 2008.

grid connection and network reinforcements. In addition, the EU Member States may require the gird operators to provide priority access for renewable energy projects and to cover part or all of the connection and reinforcement cost (Article 7 of the European Parliament and the Council of European Union 2001).

According to a recent European Local Electricity Production Report (ELEP Report), a developer of a new DG or renewable energy project is typically required to make a formal application to the host Distribution Network Operator (DNO) in order to obtain connection to the distribution network. The DNO reviews the application, determines the interconnection requirements, and then makes an offer to the developer a connection offer. The connection offer describes the terms & conditions for the connection offer, along with the details of the connection work needed to physically connect the generator to the network. As part of this connection offer, the developer is required to pay a "connection charge" that covers some or all of the costs of making the physical connection to the grid network, along with in some cases a contribution to the network reinforcement costs remote from the connection point itself that are necessary as a consequence of connecting to the generator.[65]

6.4.1 Cost of Interconnection

The EU Member States commonly refer to connection charges in the following manner:

- ***Shallow Charges:*** refers to cases where the developer has to pay for the cost of equipment to make the physical connection to the grid network at the chosen connection voltage. The developer is required to pay no fees related to network reinforcements that are needed as a consequence of the new generation.

- ***Deep Charges:*** refer to cases where the developer is required to pay for all costs that are associated with the connection of the plant including
    - Expenses for the physical connection to the nearest point on the electricity network
    - Costs for grid reinforcement that arise as a consequence of adding the plant to the network.

[65] ELEP – European Local Electricity Production Report "Distributed Generation Connection Charging Within the European Union, September 2005.

- ***Mixed Approach:*** refers to a hybrid of the shallow and deep charging approach.[66] The critical aspect of this approach is that it is important to fix the exact share of the reinforcement costs that will have to be covered by the generator.

- ***True*** – The costs paid by the generator for the new connection are equivalent to the cost of connecting the generator to the nearest point on the grid system at which the grid capacity is sufficient to incorporate the plant into the network without reinforcement.

Table 6-8 provides a summary of the connection charging methods used by the different Member States in the European Union.[67] As displayed, the majority of the EU Member States currently use the deep charging mechanism. According to the ELEP Report, deep charging is usually coupled with a significant degree of "negotiation" between the host DNO and the DG or renewable energy project developer to determine the costs of connection. Table 6-8 also displays the level of transparency in the connection charging methodology among the EU Member States. For the majority of the EU Member States, there was an overall low level of transparency, implying that it is difficult for project developers to anticipate connection charges in advance of negotiation with the DNO. Developers find that there is very little information available in the public-domain and that the terms, conditions and tariffs for connecting are not widely publicized.

[66] Examples include papers published under the EU programmes DGFER (http://www.dgfer.org/)

[67] ELEP Report, September 2005.

Table 6-8
Summary of Connection Charging Methods in the EU

	Predominant DG connection charge philosophy	Level of transparency in the system	Are there published connection cost calculation methods?
Austria	Deep	Low	No
Belgium	Shallow	High	Yes
Denmark	Shallow	High	Yes
Finland	No standard approach	Medium	No
France	Shallowish*	Medium	No
Germany	Shallow	Low	No
Greece	Deep	Low	No
Ireland	Deep	High	No
Italy	Deep	Low	No
Luxembourg	Deep	Low	No
Portugal	Deep	Medium	No
Spain	Deep	Low	No
Sweden	Deep	Low	No
The Netherlands	Shallow	High	Yes
United Kingdom	Shallowish*	High	Yes

* Intermediate step between deep and shallow charging. For example, the generator only pays the reinforcement costs at the connection voltage.

The ELEP Report surveyed the fifteen EU Member States and identified best practices related to interconnection policies. Key recommendations of the ELEP Report included the following: [68]

- Fully transparent interconnection procedures, connection charging mechanisms and connection costs should be introduced (and enforced) across Member States

- In general, connection charging for DG should follow a shallow charging philosophy. In cases where grid network reinforcement is necessary following the connection of the new DG or renewable energy project, and when pure shallow charging is not considered acceptable, it is recommended that

    - The DG or renewable energy generator is required to make a (percentage) financial contribution towards reinforcement costs, derived from the power capacity of the generator relative to the capacity of the local grid network following reinforcement. Furthermore, the reinforcement costs liability of the generator shall be limited to those costs incurred at the voltage level at which the generator is connected. This ensures that the developer is only charged in proportion to the costs of reinforcement that directly and clearly arises from the need to provide the connection.

    - The proportion of the reinforcement costs not paid for by the generator should be the responsibility of the DNO

    - The calculation methods used by the DNO in determining connection charges, along with the costs of interconnection equipment used in the derivation of those costs, shall be published by the DNO and approved by the appropriate regulatory authority on an annual basis

    - For very small generators (<10 kW), no contributions to distribution network reinforcement costs shall be required, with these costs being that sole responsibility of the DNO.

- DNO's shall be required to submit binding connection quotations to DG and renewable energy developers, including any reinforcement cost apportionment proposals, within 60 days of the developer's application.

[68] ELEP Report, September 2005.

- Prospective DG and renewable energy developers should be given the right to access the network technical parameters of DNO's system in order to facilitate the optimal placement of new generation plant within distribution networks.

- Annual connection charges levied by DNOs should only be used as a means of recovering the costs of maintaining the DNO's assets involved in the connection of the generator.

- Regulatory bodies within Member States should be given the responsibility for arbitration, in conjunction with the power to impose changes to connection charging costs and practices.

CERTIFICATE OF SERVICE

I hereby certify that I have this date served a copy of the foregoing JOINT PROPOSAL ON FEED-IN TARIFFS OF THE HECO COMPANIES AND CONSUMER ADVOCATE, together with this CERTIFICATE OF SERVICE, as indicated below by hand delivery and/or by mailing a copy by United States mail, postage prepaid, to the following:

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